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Machine Shop Milling Practice.—XVII.

By Horace L. Arnold.

The Ingersoll 36′x36″x96″ milling machine is shown in the following engravings, of which Fig. 89 is a right-hand side view with the vertical spindle in place, Fig. 90 is a right-hand side view with a large gang mill cut in process of execution, and Fig. 91 is a rear view showing the spindle drive, the table feed drive, and the quick return drive.

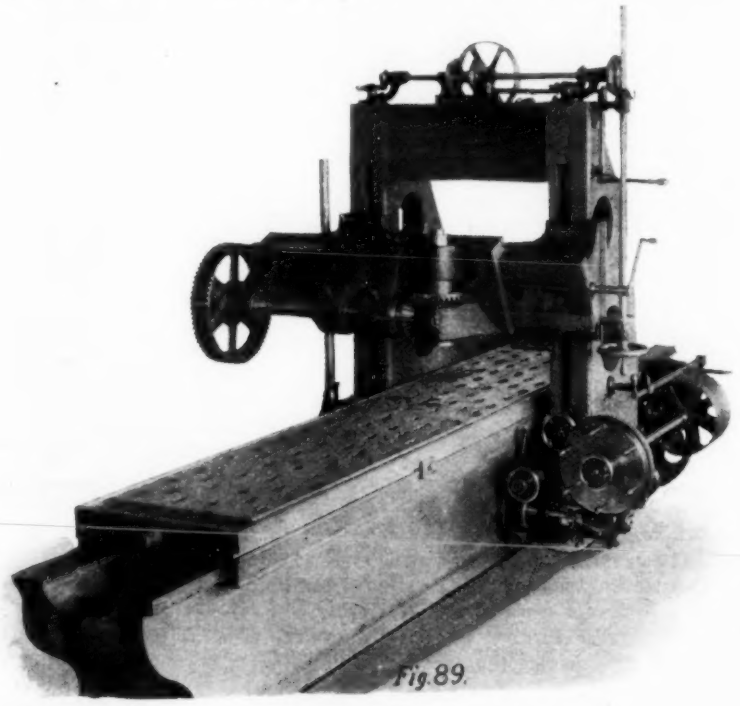


Fig. 89.

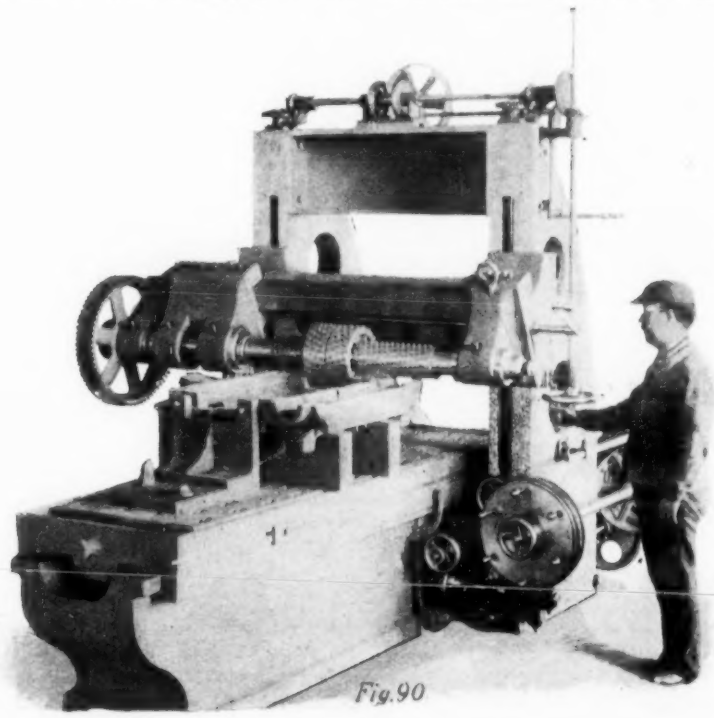


Fig. 90

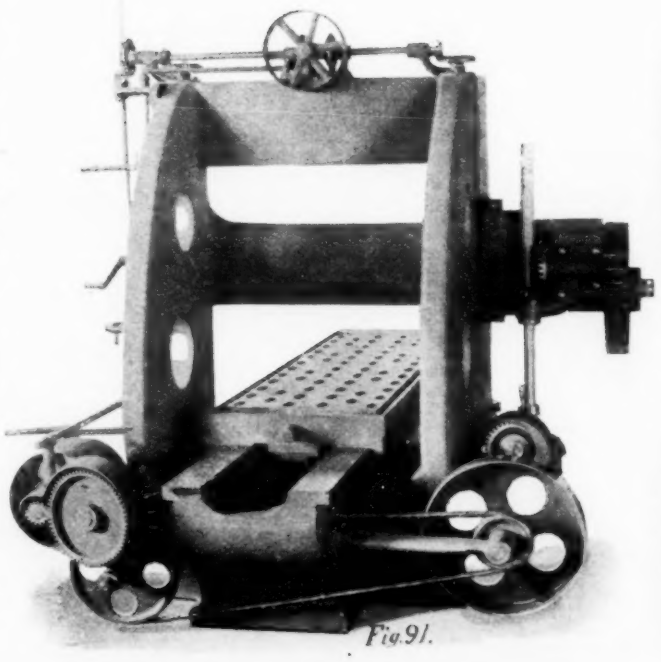


Fig. 91.

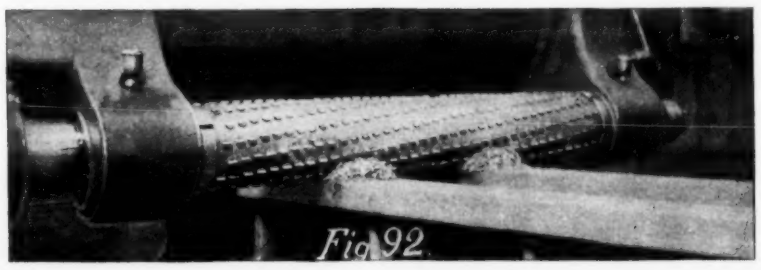


Fig. 92.

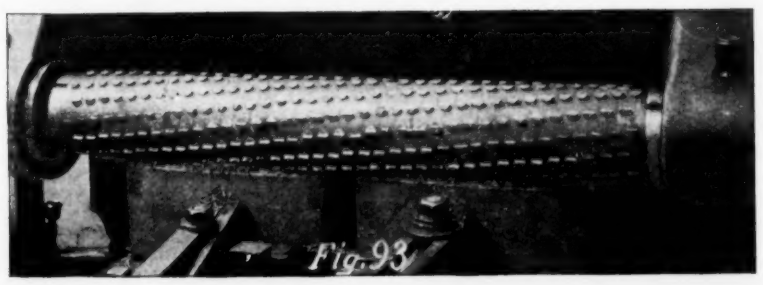


Fig. 93.

The table is 30″ wide by 96″ between pockets, and has a power adjustment in either direction at 30 feet or less per minute. Feed motion round belt or rope drive from the main cone shaft to the friction disk shaft; adjustable friction roll on the disk to give from $\frac{3}{16}$″ to 5″ feed per minute; worm reduction to pinion shaft (see Figs. 89, 90, 91), then a reduction of 3 or 4 to 1 by bevel gearing to the table driving worm shaft; the table driving worm is 5′ pitch, quadruple thread working in a plain rack secured to the underside of the table; the feed roll has a rack and pinion adjustment across the friction disk.

Spindle $5\frac{1}{4}$″ diameter, 25″ bearing, back-geared 24 to 1, with 8 changes of speed; horizontal adjustment 24″, vertical adjustment 36′.

Cutter arbor 3″ diameter, outboard bearing 10″ long. Cutters 15′ diameter and 36″ long can be used.

Driving cone 4 steps for 4′ belt. Two countershafts 280 revolutions per minute. (Detail engravings of the countershaft drive will be given.)

Pump and water tank furnished. Weight about 22,000 pounds.

The whole machine is entirely different from anything given hitherto, and has been very carefully worked out; the appearance of the machine speaks for itself; the arrangement of the vertical spindle to carry a 15″ end mill, and the arrangement of the horizontal spindle to take the same large end mill give powers in the way of making large face mill cuts which have not appeared in any other machine in combination with a thoroughly convenient and quickly handled horizontal spindle for the efficient use of large gang and slabbing (side cutting) mills. Previous illustrations have given full descriptions of machines which could use either side or end mills of large diameter on horizontal spindles, but the Ingersoll adds the substantial strongly driven vertical spindle for carrying a large or small end mill, and this harmonious combination of spindles in both the horizontal and vertical planes, is, I think, new in American practice. The idea is one which suggests itself, of course, to every designer of milling machines for general use, that is to say, milling machines thoroughly fit to go into the machine shop and take the place of planers on all sorts and sizes of work as it comes, perhaps no two pieces alike in a day's work, and turn off from four to ten times the work which a planer of the same size could accomplish. I saw two of these machines at the Rhode Island Locomotive Works, very recently placed; only one had been in operation on the day of my visit, and that making only a short cut on top of the feet of some Hotchkiss gun mounts (steel castings), which gave little information as to the real powers of the machine. At the Watts-Campbell shops, in Newark, I was afforded every opportunity to examine one of these 36′ Ingersoll machines at work, and photographs of two cuts I saw made there are given. I can say positively that this 36″ Ingersoll milling machine can be handled as quickly as a planer for flat surfacing or slabbing cuts, the quick return or table adjustment being under perfect control, and moving the table at any rate of speed up to 30 feet per minute at the will of the operator. The vertical adjustment of the cross rail reads to thousandths, with an index just above the hand wheel which the workman is turning in Fig. 90.

The hand adjustment of the table is made by the capstan handles in the large friction disk in front of the workman, same figure; the variable feed is changed by the front small hand wheel, locked by the small hand knob at the center of this feed adjusting hand wheel, and friction disk pressure is regulated by the upper hand wheel just behind the large worm gear and friction disk. The quick-power table adjustment is set in operation in either direction by pulling or pushing the shipper bar handle just below the cross rail adjustment handle; all of these hand adjustments can be made by the workman without moving from the one position. There is also a power-driven vertical cross rail movement, and the cross rail bearings on the uprights are so long that the gibs were not tightened down on the Watts & Campbell machine while at work. The widest cut I saw made was 27′, about $\frac{3}{16}$″ depth, with a feed of $2\frac{1}{2}$′ per minute.

When I first saw the Watts-Campbell machine at work the feed was only about $\frac{1}{4}$″

per minute. Having been informed that the greatest feed was 5″ per minute, and believing the Ingersoll machines capable of hard service, I asked why the feed was so small, and was told, first, that the feed drive was defective and would not give a higher speed of table, and next that some of the teeth had already been broken out of the 6″ x 30′ mill shown at work in Figs. 92 and 93.

Fig. 91, rear view of machine, shows this round belt feed disk drive from the main cone shaft on the right to the feed disk shaft on the left. This round belt drive is the only un-American thing in the design of the machine; this belt is carried through a small round hole in the frame on top, and runs close to the overhang of the frame on the bottom, and consequently cannot take a tightener. A cotton rope was in use for this drive at the Watts-Campbell shop, and the pulley grooves were not the right shape for a rope drive, and the rope was not so large in diameter as it should have been for best results and was also very slack; this combination of defects really gave a very weak drive indeed to the feed disk shaft, so light that I cannot understand how it could drive the table to take any cut. The high speed of the friction disk shaft and the double worm and worm gear reduction give a very powerful action, but the rope drive was so inefficient that it would only move the table, running light, with no work at all on it 3½″ per minute, instead of 5″ which the gear should have given. At my request the feed was put up to the full extent of 3¼″ per minute, and the machine then fed 2⅜″ steadily on a cut 18′ wide at the end, and 9″ wide where the photograph Fig. 92 was taken. The feed was steady and the cut was fairly smooth, and the spindle drive seemed to be doing no work. I have not the slightest doubt that this cut could have been much better made at 5′ per minute than at the 2⅜′ feed it had, if the feed would have driven it.

At the Watts-Campbell shops I met Mr. John Young, to whose constructive ability, perhaps, as much as to any other one factor, the enviable reputation of the Watts-Campbell Corliss engine is due. Mr. Young is himself a machine tool designer of sufficient ability to have built in and for the use of the Watts-Campbell shops a Corliss cylinder boring machine, a horizontal driller, a large boring mill, and planer attachments for finishing a Corliss engine bed at one setting, which challenge comparison for bold and effective simplicity, and perfect adaptation to their uses, and which I hope to fully describe in these columns at some future time.

There was a hesitation in the manner of Mr. Young when I asked permission to see the 36″ Ingersoll milling machine. He finally said that he had the highest opinion of the value and efficiency of the Ingersoll machine or he would not have bought it, but that there was trouble with the feed, and he had, so far, not been able to obtain the results which he expected from it. Mr. Young went into the shop with me to the Ingersoll machine, and we were told by the young man in charge of it that the feed could not be increased above the scant ¾′ per minute he was using. An investigation showed that the whole trouble lay in two most insignificant and easily perfected details. The stud back gear has been adopted for the spindle drive, and the one awkward feature of this form of back gear, the difficulty of securing a ready and efficient fixing and releasing element between the main driving cone and its shaft, has been happily met by Mr. Crocker, of Mr. Ingersoll's establishment, with the introduction of a latch pivoted to the hub of the feed shive which runs loose on the main cone shaft, and touches the main cone hub; this latch works in a slot in the main cone hub, and can also drop down into a cut in the cone shaft while still engaging the cone hub, and thus this shive latch serves three purposes; it connects the feed shive to the cone when the cone runs loose on the cone shaft, as it must do when the back gear is engaged; it connects the cone to the shaft when the back gear is out, and the cone and shaft run at the same speed, and it may wholly disconnect the feed shive from any driving member whatever; all of this is shown in a blue print which will be given later, but in the 36′ machine the driving cone is secured to the shaft for cone speed driving in the ordinary

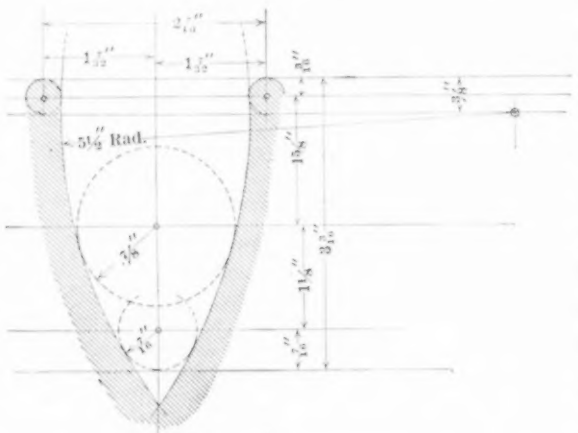


Fig. 94

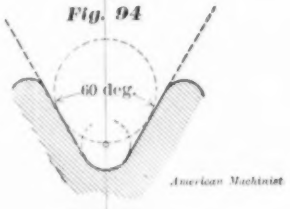


Fig. 95

manner, by a sliding stud and holding screw, and the latch is employed only to make a disconnecting drive between the main cone and the small feed shive at the right lower corner of Fig. 91. This latch has no spring stud or keeping device to maintain it in a fixed position, and it has a short hand lever as one of its members, and this hand lever stands at about 45 degrees to the plane of shive rotation, and acts governor fashion to wholly disconnect the shive from the driving cone when the driving cone is put on its quick speed.

It must be clearly understood that it was only at the highest speed that this latch showed any tendency to fly out of connection, and up to the time of my attempt to get a high feed rate had given no trouble whatever.

We tied this latch lever down with a belt lacing, and then had only the weak drive of the feed rope to contend with. A new and larger rope was put in place of the old one, without any very marked increase of driving effect, because of the faulty form of the rope grooves.

There is no fault whatever in a rope drive; it is cheaper, stiller, and smoother, and undoubtedly in every way preferable to a leather belt drive in all cases where it has not to be shifted sidewise, and, were it not for the impending reign of the individual electric motor for machine tool driving, I should expect to see leather belting finally almost disappear, in spite of the exclusive favor which the flat belt now commands in the United States. Any person who has ever stood and watched a rope drive transmitting 300, or 400, or 500 horse-power at a rope speed of, say, $\frac{5}{16}$ of a mile per minute with its dream of silent swiftness, knows that there is nothing radically faulty with a rope drive, and there is every reason, from a designer's point of view, for introducing the round belt in the Ingersoll feed drive, as it saves 6′ or so of total machine length, and gives a yielding high speed initial drive to the feed train. But the shive groove was made for the round leather belt shown in Fig. 91, and is not at all suitable for a rope drive; the groove may have been correct for a round leather belt, but this is so very little used that I really do not know whether the groove is right or wrong.

Mr. Young gave me a template to which the rope grooves in the fly-wheel of the Watts-Campbell engine which drives the linoleum mill at Kearney were made; this template was taken from a Glasgow wheel, and represents established Scotch practice; it is for a 1¼″ rope, and I reproduce a careful tracing of the template in Fig. 94, and Fig. 95 shows the form of the inefficient groove in the Ingersoll shive, which will be very soon corrected. I may add that I went to the linoleum mill in Kearney, N. J., and was shown through the place with great courtesy by Mr. Peter Campbell, the manager. The engine fly-wheel referred to is 20 feet diameter, 60″ face, and has 22 grooves to the template shown, and is intended to transmit 1,000 horse-power at 66 revolutions. Only one of the pair of engines is in place, which makes the drive so easy on the ropes that seven years' wear has had no perceptible effect on them, and they appear to be good for seven years more, and have never cost a cent for repairs. In thanking Mr. Campbell for his courtesy and extreme readiness in communicating information in regard to all the curious and very interesting operations conducted in the large establishment under his charge, I expressed my gratification for the absence of all reserve. In reply Mr. Campbell said: "The day for locked shops and trade secrets has gone by; if my competitor has not sufficient ability to find out what I have in my place I need not fear him; if he has that ability I cannot avoid him: in either case I might better open my doors." In further conversation Mr. Campbell said: "Every shop and factory has its points of superiority; no one is better at all points than any other; the true policy is a free interchange of thought and practice, for only good judgment and sound business management can win in the long run; a mere shop secret more or less does not count in this day of ready communication."

The cuts shown in Figs. 92 and 93 were made with a 14-toothed 6″ diameter Ingersoll mill, 15 revolutions, and 2⅜″ per minute feed; as stated, this feed should have been 3¼″ per minute, the difference being wholly due to slip of the rope in the shives, and I repeat that I do not see how the machine could have fed these cuts of 18″ and 27′ width at any speed whatever with such a weak feed drive; either the Ingersoll mills cut more easily than any others I have seen at work, or else there is some hitherto unknown virtue in the Sellers table drive used in the Ingersoll machine. The figures for these cuts are

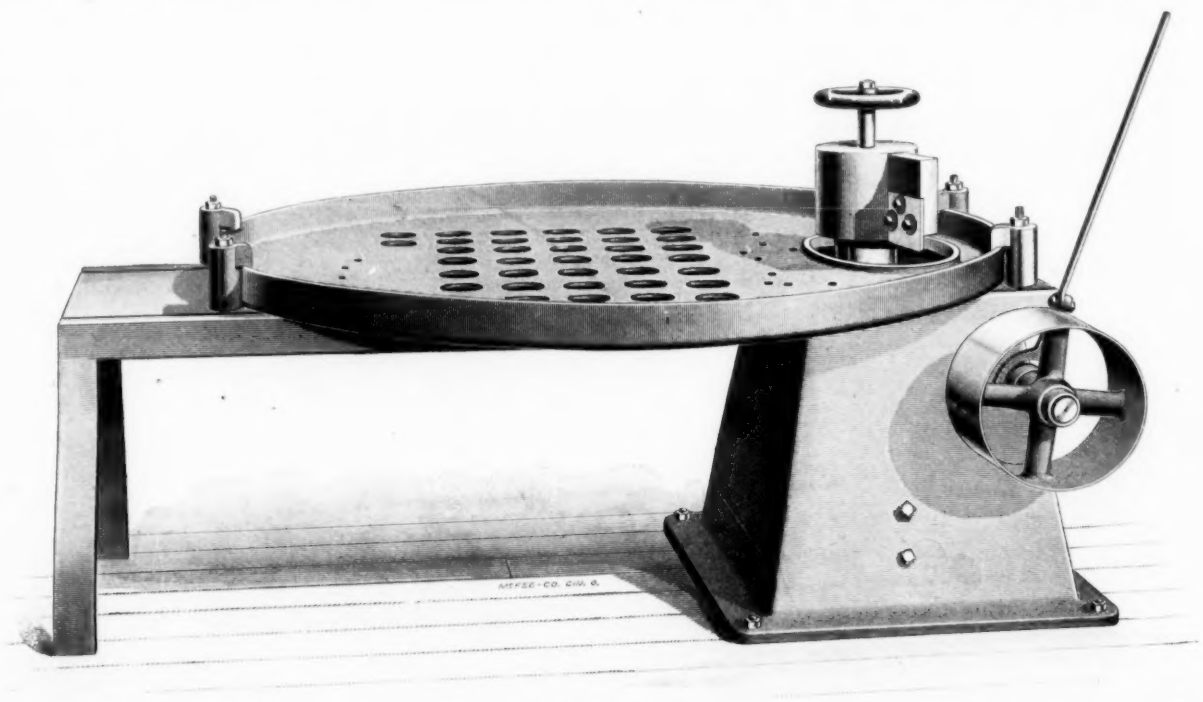
Surface speed of mill, 23½ feet.
Cuts per inch, 90 (nearly).
Feed per tooth, 0.0113″.
Feed per revolution, 0.1582′.

The surface was smooth, the revolution mark very shallow, and the work with a good straight-edge showed one thickness of tissue paper crowning in 27′ width of the first cut, which was about $\frac{5}{16}$ deep; this $\frac{1}{1000}$″ or so may have been due to spring of the very long 6′ mill, shown in Figs. 92 and 93, or to imperfect support of the *two* pieces which were bolted down side and side, as shown in Fig. 93, to make the 27″ width of cut. I should have made further experiments, but the work was mainly small short cuts which gave no information except as to the extremely handy character of the tool generally. Too much praise cannot be given to the feed and table handling devices; they put the table under perfect control of the operator, and that without loss of time for any of the varied functions.

I have given the figures for the rope groove template, and they have the value of representing successful and long continued practice.

Man-hole Facing Machine.

The machine which we illustrate herewith is intended especially to rapidly and accurately face off rough edges on flanges of boiler heads and other similar work.



FLANGE FACING MACHINE.

Heretofore this work has usually been done on the planer or shaper, much time being necessarily consumed, and recognizing that a rotating cutter would be more efficient for such work, this machine was designed for it.

This tool is extremely simple in construction, and needs but a brief description. By referring to the cut, it will be observed that a boiler head is clamped in position on the

table by four bolts passed through the clamping dogs, which securely fasten the head to be operated upon. T-slots extend the entire length, permitting diameters from 12″ to 78″ to be clamped to the table.

The table is mounted on cast base, 30″x 30″x24″ high, and has a bearing cast on the bottom 6″ long, into which steel spindle 5″ in diameter, 30″ long is fitted, extending into bearing 8″ long in bottom of base. The machine is driven by a steel worm 14′ diameter, 1′ pitch, accurately cut. The worm wheel has 40 teeth hobbed from solid blank, and arranged with oil pan, insuring perfect lubrication. A cutter head is mounted on the upper end of the spindle, provided with driving feather and gib, and is fed up or down by the hand wheel on the end of feed screw, regulating the amount of cut desired.

Ordinarily, a man-hole 11′x16′ may be faced off in 10 to 15 minutes, making a clean, smooth job. The machine is built by The Liberty Mfg. Co., Liberty, Ind.

New Triplex Power Pump for High Pressures.

The Gould Mfg. Co., of Seneca Falls, N. Y., has recently brought out a line of power pumps intended for heavy duty, such as is called for in hydraulic presses, filter presses, cranes, lifts, punching, riveting and flanging machines, forging, testing, and all operations demanding extraordinary endurance and reliability.

The accompanying cut represents the "triplex" type, which works under pressures up to 5,000 pounds per square inch.

The strains in this pump when under such pressures are eased by a differential arrangement, one plunger being considerably larger than the others, and this is automatically cut out when the pressure rises to a certain point, so that there is none of the shock and racking effects that are common with some pumps, while initial rapidity of action is retained.

These pumps have cast steel crank-shafts working in bronze bearings. The connecting rods are of forged steel, with strap and taper adjustment for crank-pins, and are made long to avoid side stress on guides and framing.

The larger sizes have crosshead shoes of bronze with taper adjustment. All bearings are easily accessible for inspection and adjustment, the wearing surfaces are ample, and the oiling arrangements are of the best. The larger sizes have extra heavy uprights, between which the cylinders, etc., are solidly bolted, forming a rigid frame.

The smaller pumps are made with uprights, crosshead guides, and cylinder supports in one casting.

The valves and valve seats are of simple design, readily accessible, being covered by an easily removed cap.

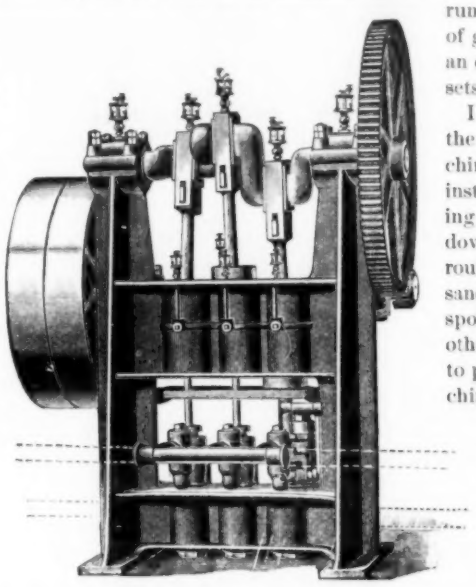
The plungers are made of material best suited for any particular service, and are packed by a cup leather of original design. The company aims to have design, materials, workmanship and finish of the very best, and careful attention is given to cases involving special requirements.

Twenty-one-inch Pillar Shaper.

We give on this page an engraving of a twenty-one-inch shaper, which, though similar in design to others of the same line illustrated in our issues of September 13th and December 6th last, is somewhat different in having the ram slides extended out beyond the face of the column, for better support, and in having a squared shaft connected by bevel gears with the screw, by which the position of the ram is adjusted. This squared shaft, as shown, is near the head, convenient for the operator, and the same crank handle fits this, the feed-screw and the shaft for moving the platen vertically. Both feed-screws are provided with micrometer graduations, which are convenient in rack cutting and other operations.

The high-speed pinion is made of the new process raw hide, making the machine run almost noiselessly.

The other features of the machine have been previously explained, and it is only necessary to say that it is intended to be



TRIPLEX POWER PUMP.

capable of doing heavy work within its capacity, and is extra heavy. It is built by the Lodge & Davis Machine Tool Co., Cincinnati, Ohio.

English and American Woodworking Machinery.

We published in our issue of January 17th, a letter addressed by an American to an English contemporary on the above subject, and think it no more than fair to print also the following reply to it which appeared in *The Engineer*:

SIR—As a designer and constructor of woodworking machines, I am naturally interested in the correspondence just now appearing in your columns anent this subject.

My experience of American wood machinery is that, as a rule, they are too light and unsubstantial for British use. Referring more particularly to high-speed machines, the cutter spindles are unduly slight, and running, as they usually do, in white instead of gun metal, they and the bearings become an endless source of trouble so soon as wear sets in.

I am free to admit, with Mr. Worssam, the ingenuity of some of the Yankee machines, and that a few are useful here; for instance, Fay and Egan's "buzz," or jointing and hand planer, the Stengel and Knapp dovetailers, the Albee and other carvers and routers, Fay's double and triple spindle sand-papering machines, the Blanchard spoke lathe, box nailing, and one or two others, but these are the exceptions that go to prove the rule. Although very good machines, I do not regard them as "veritable wonders," neither do I acknowledge that their comparatively limited employment here is damaging English manufacturing interests, and rapidly edging English-made machinery out of the field, as your correspondent of Cincinnati would like your readers to believe. I take it the wish is father to the thought. I likewise do not see any evidence that we wood-machine makers are behind the times in the getting up of up-to-date machinery of our special kind. On the contrary, I believe we set the standard of design, adaptability, and workmanship, and Brother Jonathan follows as closely as possible in our wake. Take, for instance, the band-saw, now universally used in the States, and, in fact, throughout the world wherever timber grows. This interesting and invaluable instrument was in vogue in France and England years prior to its acceptance in America. This shows that our cousins beyond the seas can be as conservative in these matters as others, and are not always prepared, as they affirm, to seize every and sundry labor-saving tool immediately it comes to light. All reason for wonder at the large demand there is in America for this type of machining extraordinarily fast steam yachts, launches, etc., at East Cowes, Isle of Wight, has now gotten things into such shape there as to be able to leave his son in charge of the mechanical department while he has returned to America, and will organize here companies to manufacture and push his inventions pertaining to motive power of very, and the multitude of makers thereof, cease so soon as one considers the illimitable extent of American forests, the endless varieties of woods, the high rates of wages commanded by skilled woodworkers, and the innumerable purposes for which wood is in request there; whole "cities," as is well known, being built of this indispensable and natural material.

I understand that a township of some 2,000 inhabitants, with those of the surrounding villages, will entirely monopolize a saw-mill and wood-cutting establishment, fully equipped with saws, planers, molders, joinery and similar machinery, for building and general woodwork.

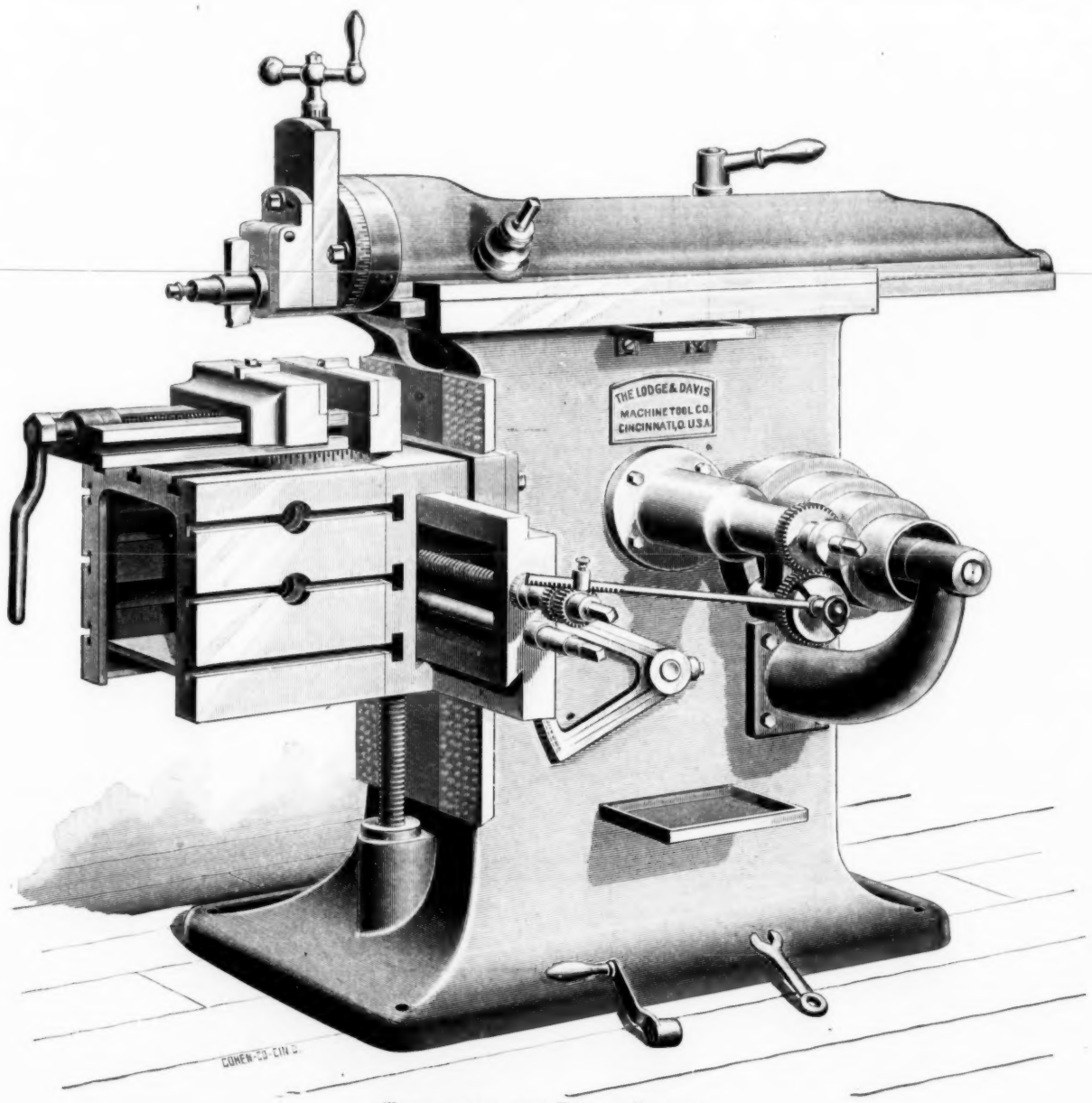
Again, the Americans employ a large number of machines specially suited to the work necessitated by local conditions, and which are of no service elsewhere, such as the gauge edgers, "trimmers," "slashers," etc., so graphically described in your article for September 29, 1893, on "Machine Tools at the Chicago Exhibition."

Did space warrant, I could dilate still further on this subject, but I think I have said sufficient to refute the altogether erroneous and misleading averments of your correspondent "J. T. B.," of Ohio, that (1) "American woodworking machinery is damaging English manufacturers' interests," and edging ours into the cold; and (2) we are not up to date in a branch of mechanical industry we have specially made our own.

ÆNEAS SMITH.

Lot's Road, Chelsea, January 2d.

Mr. Henry A. House, Sr., the American engineer whom we have formerly referred to as being connected with a company build-



TWENTY-ONE-INCH PILLAR SHAPER.

sels, road vehicles, and for industrial heating. Mr. House has a burner which enables the use of residuum oil—oil which has been and is being thrown away, and his new reversible engine for small vessels weighs about one pound per horse-power.

Experiments on a System of Governing By Compression.*

BY JOHN H. BARR.

The effect of compression upon steam engine economy has been a subject of discussion for a long time. Several papers recently presented before this society have revived the consideration of this topic, and have been followed by some experimental work; but it is probable that further investigation will be required to settle many of the points involved. The writer of the present paper became much interested in one phase of the question some time since, and was led to begin a theoretical and experimental study, which, if not the direct consequence of the earlier work on the subject, has given some results having a bearing upon previous discussions. This work is not yet as complete and exhaustive as it is hoped to make it; but the experience is related now because it is thought to offer experimental data of some possible interest.

These results are not presented as conclusive evidence, and they do not fully accord with what seems to have been a somewhat prevalent idea; or, rather, they indicate that this idea, while correct in a general way, exaggerated the effect of certain phenomena. . . .

It has been well known for a long time that a given engine with given initial pressure, etc., operates with the lowest steam consumption per horse-power per hour at a certain point of cut-off, and that a variation of the point of cut-off either side of this point is accompanied by a higher rate of steam consumption. With a given initial pressure, back pressure, speed, and point of exhaust closure, each point of cut-off corresponds to a definite mean effective pressure and horse-power.

A lighter load is usually met by an earlier point of cut-off, and a heavier load by a later cut-off. The rate of steam consumption over the best economy usually increases faster for an earlier cut-off than for a correspondingly later cut-off. The latter change results in a higher terminal pressure, with greater loss through free expansion, but this is in part compensated by a reduced rate of cylinder condensation and re-evaporation. . . .

The mean effective pressure can be reduced to meet the requirements of a light load either by reducing the mean forward pressure or by increasing the mean back pressure. The waste per horse-power through cylinder condensation is proportional to *condensation (actual)*. The former method mean effective pressure reduces the denominator of this expression, but tends to increase the numerator at the same time, while the latter method reduces both numerator and denominator; hence it should be the more efficient means of securing a required reduction of mean effective pressure, so far as the condensation waste controls efficiency. In many instances, notably in electric railway plants, the engines run at much less than the most economical load, a great deal of the time. This is probably often the result, in part, of a too literal adherence to the injunction, "When you are gittin', git a good deal," in buying too large an engine; but it is due more to the necessity of providing power for the occasional excessive loads to which these plants are subject. To meet the requirements of such service, an engine is needed which will run with reasonable economy at considerable less than the best load. The very heavy loads usually last for short periods only, and have correspondingly less effect upon the running expenses. From trials and observation of the performance of such plants, the writer became much impressed, something over a year ago, with the idea that a suitable system of compression governing might improve the economy of an engine under light loads. This was by no means a new idea; it has probably occurred to a great many engineers. . . .

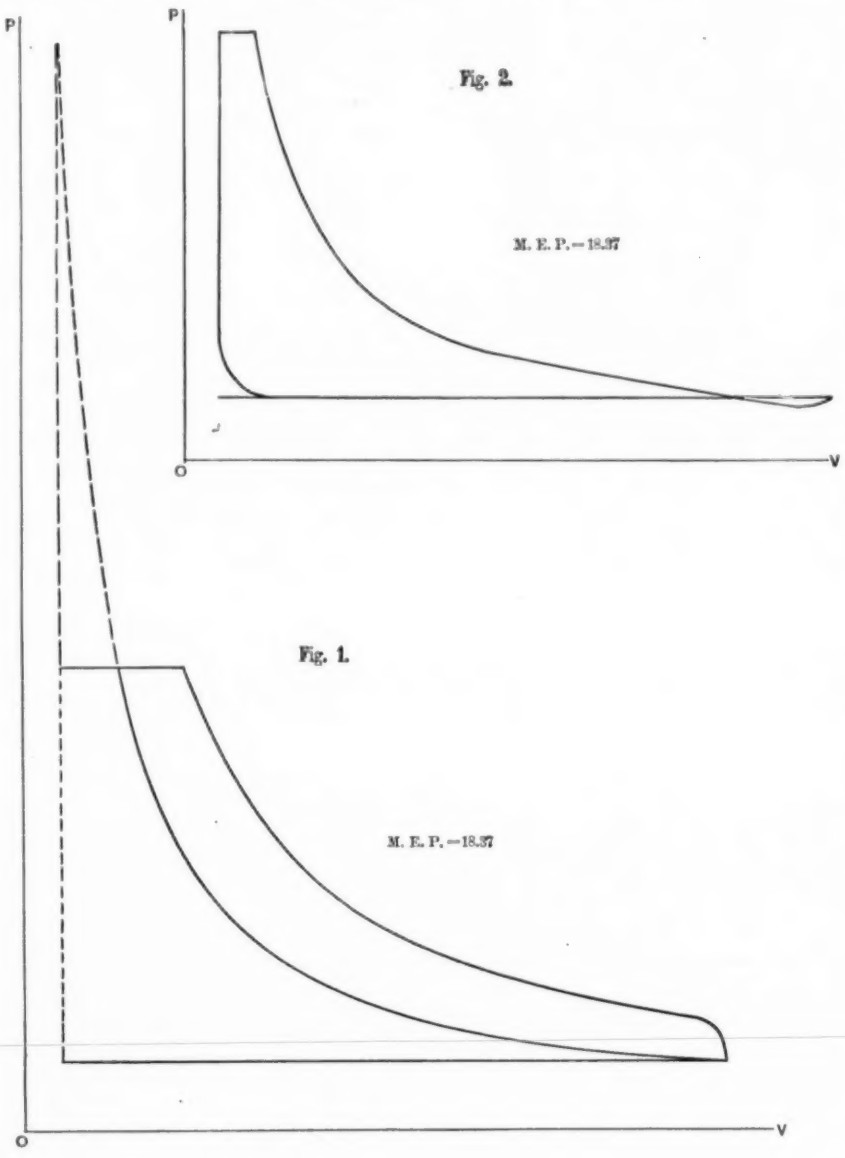


Fig. 1.

Fig. 2.

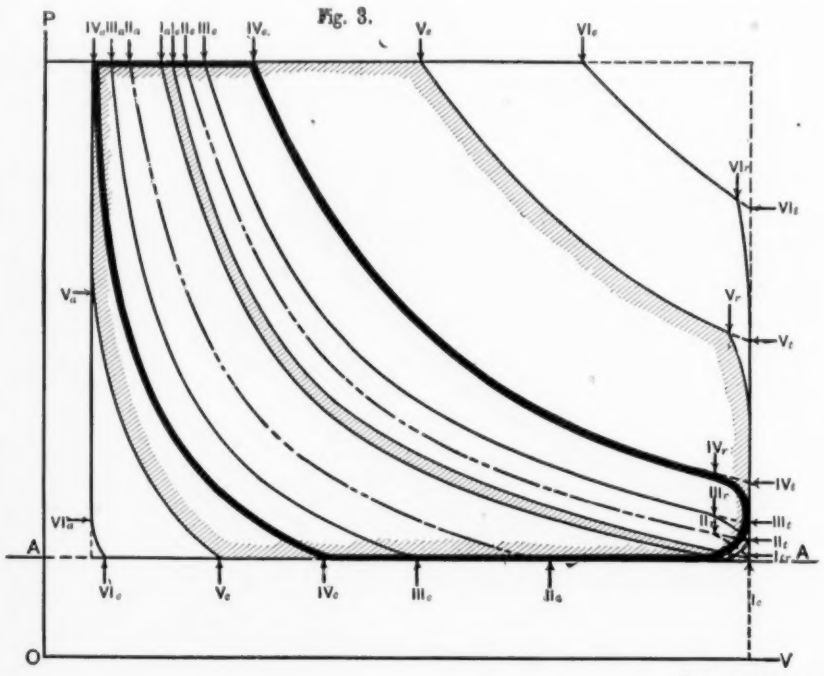


Fig. 3.

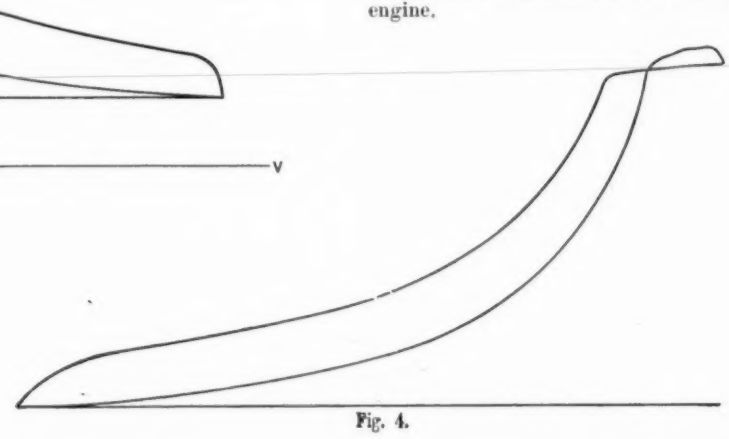


Fig. 4.

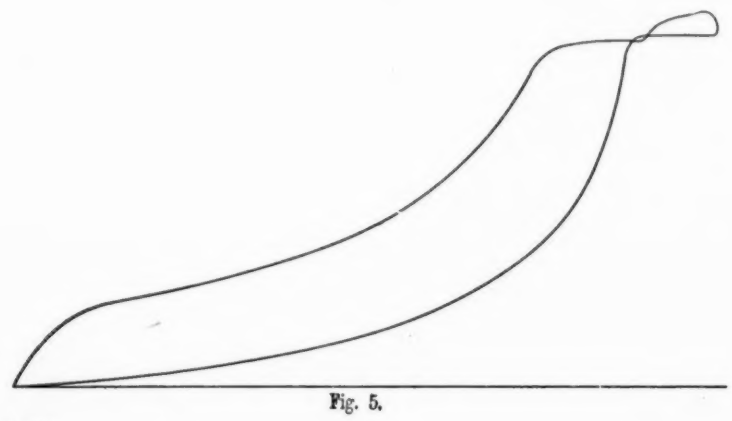


Fig. 5.

GOVERNING BY COMPRESSION.

Fig. 1 shows an ideal diagram such as might be obtained by this method of compression governing, while Fig. 2 shows a diagram for an equal mean effective pressure as obtained by the usual method of regulation. . . .

To meet a resistance greater than the most economical load cut-off occurs later, accompanied, as in the ordinary single valve automatic, by somewhat less compression; to meet a lighter load, the compression is increased, but the point of cut-off remains fixed; that is, the reduction of mean effective pressure is effected entirely by a change in the point of exhaust closure. . . .

The peculiarity of the steam-valve action is that for a change of the governor to one side of the position corresponding to the best load, the cut-off becomes later, and lead does not vary greatly, while for a change in the other direction the lead increases considerably and the point of cut-off is shifted but little. The exhaust valve permits great range for exhaust closure, while maintaining an almost constant release. Fig. 3 shows a series of ideal diagrams covering a wide range of load. Each diagram is designated by a number, beginning with *I* for the lightest mean effective pressure. Thus the outline *I V a, I V e, I V r, I V c* (shown by the heavy line), is the diagram corresponding to the assumed best load. The subscripts *a, e, r, c*, designate points of admission, expansion (cut-off), release and compression respectively. . . .

The trials were conducted with great care, and several of them were repeated. The exhaust steam was condensed in a surface condenser and weighed. Indicator cards, gauge readings, etc., were taken every ten minutes, and water measurements were taken at the signal for the other readings, and also when each tank was filled. The latter water readings were, of course, the more accurate, although the partial readings checked the totals within a fraction of a pound, and the practical constancy of these partial readings showed a very regular rate throughout each trial. The brake was kept at a uniform load by a man who watched it continually.

Table I. gives the data obtained from this series of trials:

These results show *nearly the same water rate under either system of governing*, although the small difference is in favor of the ordinary method.

The rate is high in both cases, but the light loads and the proportions of the engine would lead us to expect low economy. The engine is 9 inches in diameter by 36 inches stroke, and the clearance is large for a Corliss engine.

Figs. 8 and 9 give a thermal comparison of diagrams from the trials under the smaller brake load with the compression system and with the usual method of regulation, respectively. This analysis was made by Mr. Thomas Hall. The saturation curve, as drawn in each case, shows the expansion line that would have been obtained had all the steam used per stroke remained dry and saturated throughout the expansion period. The ratio of the steam accounted for by the diagram at any point to the steam shown by this curve gives the quality of the steam at

*Presented at the New York meeting (December, 1894) of the American Society of Mechanical Engineers.

TABLE I.

	NET BRAKE LOAD, 104 POUNDS.				NET BRAKE LOAD, 216 POUNDS.	
	Compression.			Corliss.	Comp.	Corliss.
	A	B	D	E	C	F
Mean steam pressure	109.5	107.0	111 5	113.8	110.6	113.3
Mean rev. per minute.	83.45	83.46	83 45	86.69	81.75	85.95
Steam per hour, pounds	616.0	611.6	604.0	575 7	890.3	780 8
Indicated horse power	12.86	13.90	13.98	13.10	24.84	24 53
Delivered horse-power	10.87	10.87	10 87	11 29	22.10	23 24
Steam per I. H. P. per hour.	48.00	43.90	43 20	43.95	35 80	31 85
Mechanical efficiency per cent.	84 53	78 20	77.8	86.2	88.98	94 74

that point. It appears from these limited experiments that reducing the mean effective pressure by increasing the back pressure does materially reduce cylinder condensation, as we had been led to expect; but we did not secure a net saving in steam.

We have not as yet been able to conduct further trials with a view to tracing out the compensating losses, and must resort to somewhat speculative methods to account for the results obtained.

The waste through free expansion with the high pressure at release in our compression trials may account for the entire loss; but an investigation made since our trials by Mr. E. T. Adams, in the Sibley College laboratories, leads to the suspicion that there is another factor in this loss which we had not previously rated at its full value.

Mr. Adams conducted a series of trials upon cylinder condensation by using a thermopile in the cylinder head. He placed his junctions within $\frac{1}{100}$ of an inch of the internal surface of the cylinder, and by means of very careful preparations and the use of an extremely delicate galvanometer he secured a photographic diagram of the temperature changes in the cylinder wall. This work shows that the exhaust waste occurs, very largely, immediately after release by a rapid boiling away of the condensed steam, and that the loss during the later part of the exhaust stroke is comparatively small. By reference to Fig. 8 it will be seen that we had about 73 per cent. steam and 27 per cent. water in our cylinder at release, with the compression trials, and it is very probable that this water was nearly all re-evaporated during the short time that the exhaust valve was open. This would account for an exhaust loss out of all proportion to the time the exhaust valve was open.

It seems probable that the free expansion loss and this almost instantaneous exhaust loss are sufficient to account for the poor showing of these compression trials. It is hoped that a quantitative determination of the influence of each of these factors may yet be made, for they would not be without interest, even if of no direct commercial value.

While it is decidedly unsafe to draw conclusions from such limited data, these few trials indicate, as far as they go, that, whatever the possible gain from using compression as a method of governing may be, it will probably prove effective in ameliorating the wastes of the steam engine only to a limited degree, under ordinary circumstances.

There are two conditions under which it is possible that the compression method of governing may yet prove advantageous to some extent: first, with steam pressure so low that the ordinary distribution gives a large loop at the end of expansion with light load, and, secondly, with compound engines.

It is hoped that an engine recently built at the Sibley College shops will afford means of applying the method to these cases in the near future.

It seems like a somewhat roundabout way of lighting the cars on the Brooklyn Bridge to stretch a trolley wire over the tracks from which to take the current for lighting while a cable does the propelling, but perhaps that is the best way of doing it.

A new artificial horizon has been devised by a French naval officer. An aluminum top is spun in a vacuum, and the motion of a circle on the upper surface of the revolving cone, determines the true horizontal plane.

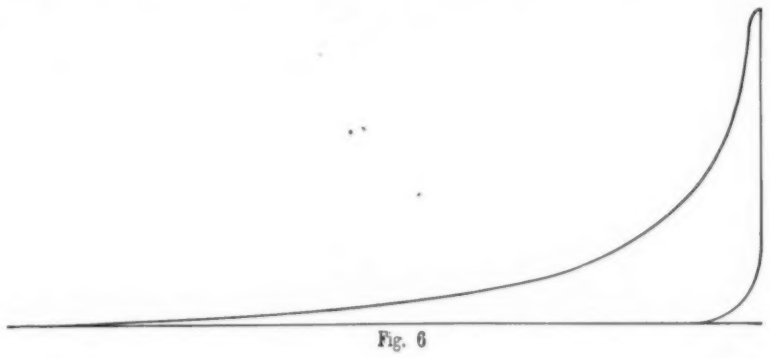


Fig. 6

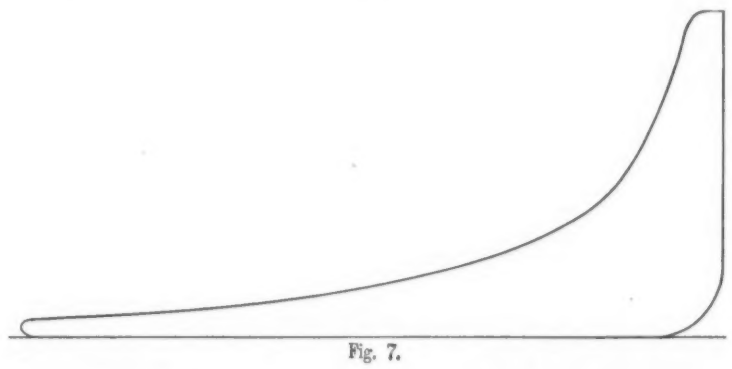


Fig. 7.

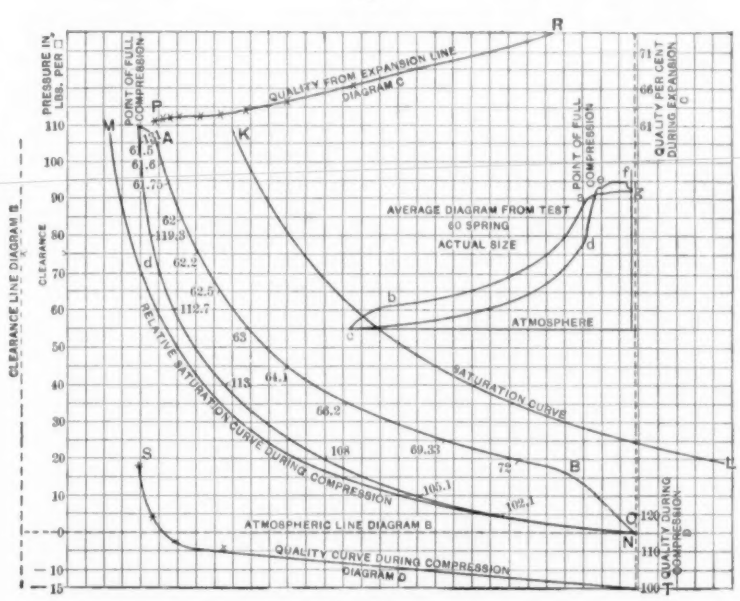

PRESSURE IN LBS. PER □
CLEARANCE LINE DIAGRAM B
POINT OF FULL COMPRESSION
QUALITY FROM EXPANSION LINE DIAGRAM C
AVERAGE DIAGRAM FROM TEST 60 SPRING ACTUAL SIZE
ATMOSPHERE
SATURATION CURVE
RELATIVE SATURATION CURVE DURING COMPRESSION
ATMOSPHERIC LINE DIAGRAM B
QUALITY CURVE DURING COMPRESSION DIAGRAM D
QUALITY PER CENT DURING EXPANSION C
QUALITY DURING COMPRESSION D

FIG. 8.

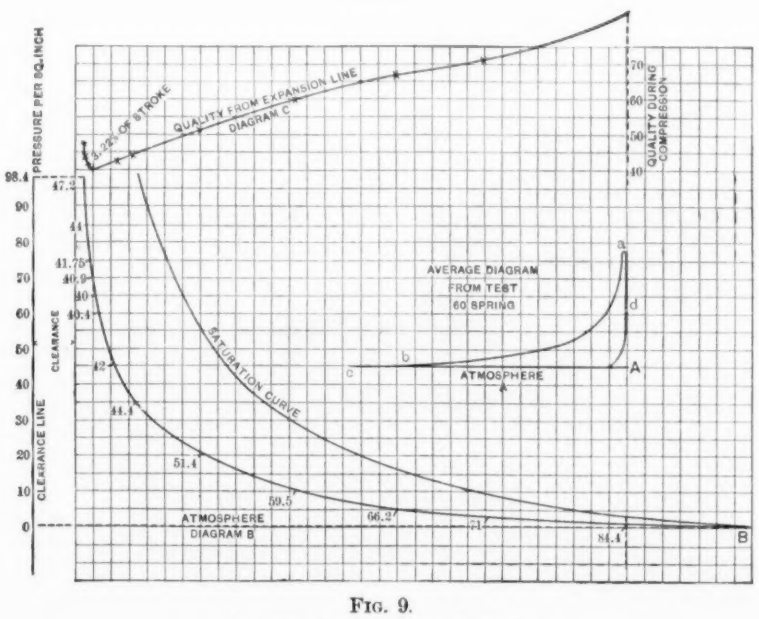


FIG. 9.
GOVERNING BY COMPRESSION.

The managers of two of the oldest cotton-mills in Lowell, Mass., are reported to be preparing for establishing mills in the Southern States.

Weight and Mass.

BY PROF. DE VOLSON WOOD.

A correct knowledge of the fundamental terms used in science is of the greatest importance. It is necessary for the student not only that the wordings of the definitions be correct, but the ideas involved should be presented in various ways so as to enable him to make use of his knowledge in cases which are new to him. In determining the real nature and distinction between weight and mass, it is necessary to include the idea of force, and to study the relations due to the action of force upon bodies.

I have, from time to time, asked young men who had studied physics considerably, and who had, presumably, a fair knowledge of the subject, the following question: If a sled weighing 20 pounds were placed upon perfectly frictionless ice, would it be possible for a pull of 10 pounds to be exerted upon it? Some answer "no," because, they say, that the least force will move the largest free body—or some say there is nothing to resist the force, and so a force so large as 10 pounds could not be exerted.

WEIGHT AND MASS.

Again, I have asked: If two sleds, each weighing 20 pounds, were placed upon frictionless ice and connected by a string, and a pull of 10 pounds be exerted on the foremost sled, what will be the tension on the string *A* connecting the sleds? Frequently, about half the class will answer 10 pounds, and the others 5 pounds. Erroneous answers at once reveal the fact of ignorance of the relation between force, mass, space and time.

A student will admit, either as the statement of an author, or after proof, that a body at the center of the earth will weigh nothing; also, if the earth were a homogeneous spherical shell, the hollow having the same center as that of the sphere then a body placed anywhere in the hollow would weigh nothing. Let *B* be such a body. If a string *B C* pass from it to the surface of the earth through a hole at *C*, then it is easy to imagine that a person by pulling upon the string can move the body *B*, that the least force will move it *very slowly*, a greater force more rapidly, and so on, and that the distance passed over the first second will depend upon the magnitude of the pulling force. If this be admitted, it will at once be seen that a force however great may, mechanically speaking, act upon a body however small. Given the weight of the body, say, 2 pounds, and the pulling force, say, 1,000 pounds, and the mathematician will tell how far the body will be moved in one second, or one minute, or any other time. (He would find it to be about 8,050 feet in one second, and more than 5,400 miles in one minute.) Now, conceive a large weight, say, 1,000 pounds if weighed on the surface of the earth, be substituted for the 2-pound one at *B*. As before, the least pull will move this body very slowly, but if the pulling force be 1,000 pounds, it will move it only $\frac{1}{500}$ as fast as it did the 2-pound body (hence it would be moved about 16 feet the first second, and about 11 miles the first minute).

These bodies under the conditions assumed are without weight, and if the student is impressed with the fact that the motion of a body depends upon its quantity of matter, as well as upon the force, he has a fundamental idea of dynamics.

The quantity of matter is called mass. It is independent of place or circumstances. A body has the same mass whether it be within the earth, on the surface of the earth, at the top of the highest mountain, a thousand miles from the earth, on the moon, or on the sun, or anywhere else in the universe. Mass is the most absolute thing with which we have to deal. It is mass, or, in other words, matter, that is moved by force.

It is the force of gravity that causes weight. The force of gravity is equivalent to a pull downwards, and the amount of that apparent pull is the weight. The force of gravity also gives motion to falling bodies. At the surface of the earth gravity will

give to a body falling from rest (in a vacuum) about 32.2 feet the first second. If a body weighed one pound by a spring balance on the surface of the earth; then if that body could be taken down a very deep mine, or so far above the earth that the velocity produced by falling one second was one-half as much, or 16.1 feet, then would the body weigh only one-half of a pound at that place by the same spring scale. Or, generally, if W be the weight of a body where the velocity produced by gravity in one second were g, then would $W \div g$ be constant, and, being constant, it is taken as the measure of the mass; so that if M be the mass we would have

$$M = \frac{W}{g}.$$

Some wise fellow now thinks to catch his teacher and asks, How can the mass of a body be found in the hollow sphere above referred to, where W and g are both nothing? We answer in the same way, ideally; for if the person pulled with a constant force of F pounds at C (see figure above), and thus produced a velocity of a feet the first second in the body B, we would have

$$M = \frac{F}{a};$$

for if the force F were doubled the velocity a would be doubled, and hence the ratio would be constant. If the force F equaled that of gravity on the earth, then $F = W$, and a would equal g, so that we would have

$$M = \frac{W}{g}$$

as before. From the preceding equation we have

$$F = M\,a = \frac{W}{g}\,a,$$

which is a fundamental equation of dynamics.

This mechanical laboratory at the center of the earth is very useful to those who are able to conceive of the abstract relations there existing. We will give two more illustrations:

Conceive a boy to have a footing somewhere in the hollow, or, if necessary, let him be tied to the shell; then if he whirl a stone in a sling, although the stone would weigh nothing, there would be the same pull on the string—or on his finger—as if he were upon the surface of the earth, where the stone might weigh a pound or more. In the hollow, it is the mass, or matter in the stone, which resists the force which continually acts to prevent its going in a straight line and compels it to move in the arc of a circle. The force acting on the stone to draw it away from a tangent line is centripetal, and the reaction, or pull on the finger, is centrifugal. If M be the mass of the stone $= W \div g$, R the length of the string and v the velocity of the body in feet per second along the circumference of the circle, it is found that the pull on the finger will be:

$$F = M\,\frac{v^2}{R} = \frac{W}{g}\cdot\frac{v^2}{R}.$$

Again, if the fly-wheel of an engine were placed in this hollow, it would weigh nothing, but if rotated on its axis there would be the same tendency to burst as if rotated with the same velocity on the surface of the earth. (To be strictly accurate, the wheel on the earth should have its axis vertical, so that the weight of the rim would not act in the plane of motion.)

This principle was used by Sir Isaac Newton to prove that the force of gravity varied inversely as the square of the distance from the center of the earth. Thus, if M be the mass of the moon, then the force which must constantly pull on the moon to draw it away from a tangent and make it go in a circle about the earth would be, as above,

$$F = M\,\frac{v^2}{R};$$

where R is the distance of the moon from the earth in feet, and v is the velocity of the moon in its orbit in feet per second. If the moon were on the earth's surface its weight would be $W = Mg$, and if the law of the inverse square of the distance be true, and r be the radius of the earth, then at the distance of the moon it would weigh

$$M\,g\,\frac{r^2}{R^2},$$

and this would represent the force of gravity on the moon; hence

$$M\,\frac{v^2}{R} = M\,g\,\frac{r^2}{R^2};$$

or,

$$v^2 = g\,\frac{r^2}{R}.$$

This equation was found to be true, and hence Newton's law was proved to be true for the moon, and finally for the whole solar system; and so by this apparently simple method the grand law of gravitation became established.

LETTERS FROM PRACTICAL MEN.

The Proposed New Screw Thread.

Editor American Machinist:

In reply to your request for my opinion on the proposed screw would say that I am the originator of this thread, but not in the shape that you published it, and in this connection I must beg leave to protest against the thread in the garbled form in which it has been presented to you. I send you a copy of a paper I read some time since before the Washburn Engineering Society, at the Polytechnic School, and which will appear in the next monthly issue of their publication. A paper I had prepared for the Franklin Institute, but had delayed sending, owing to appearance in print of this thread from a Western concern, whose typography had most glaring faults and evidently had no reviewing, as the formulæ as given would not in certain instances give the tabulated results.

A circular while composed identically word for word in its heading paragraph and in other portions of its tables from my original computations, your humble servant had no recognition whatever, but it was to be inferred that the concern who named and signed the circular were the originators of the screw.

This paper I had prepared I have now decided to send together with explanation. You will upon looking through the paper get the whole history of the new screw thread from its conception, together with tables and diagrams and reasons therefor. It is true I gave Mr. A. W. Handy a copy of my formulæ and table of construction from which he was to get gauges made; the matter was submitted to Brown & Sharpe Manufacturing Company, who, after looking it over, insisted that it would be necessary to make two gauges—one for the tap and one for the screw threads if the formulæ I gave were followed; this was necessary on account of the clearance at top and bottom of thread. This suggestion is obviously a mistaken one, as anyone can see after looking at my diagrams and formulæ. This suggestion, or rather change in depth, was given Mr. Handy and he accepted it without consulting me.

A new table it seems was made and gauges made from this suggestion of Brown & Sharpe.

Now the fact is I have experimented with 29-degree threads and have taps made several years back and in daily use, but, as I have stated in my paper, "at the earnest solicitation of a prominent builder of bolt and nut machinery to devise some form of angular thread to replace the square thread," I experimented and made calculations of which the outcome is the angular thread I now submit to you. I made taps and screws from my formula nearly a year ago, and shortly afterwards Messrs. Prentice Bros., of this city, made taps and screws after my formulæ which have had constant use, and neither of us have found the necessity of the extra gauge, claimed to be imperative if my computations were followed out, and we have the necessary clearance, and the depth of our thread is like the old square thread which can be measured without recourse to micrometer calipers.

A careful examination of my paper, together with the diagrams and tables, will show that my position is correct, and that a screw made from my tables will meet all desired ends and will require little, if any, talking or urging to its being adopted by the engineering world.

I suggest making a comparison between the "*Powell-Brown & Sharpe-Handy-Acme Standard*," which you have published, with its elaborate mystifying formulæ, with its depths of threads in one-thousandths and ten-thousandths of an inch, with the original "Powell angular thread" having its simple formulæ and depth of threads always in dimensions found on the workman's scale, and which he can measure without the use of micrometer calipers, as are necessary in the so-called "Acme Standard."

Again, the top of the thread in the Powell angular thread is the same as the width of space at bottom of thread, and the thickness at root of thread is equal to width of space at top of thread, being similar in this construction to the Sellers or U. S. S. thread, as well as all standard threads. If clearance is desired it can easily be gotten by making the tap $\frac{2}{100}$ inch larger in diameter than the screw, and cutting the thread on the tap so that the diameter at bottom of tap is just the same as the diameter of screw at bottom of thread, and by boring out the nut $\frac{2}{100}$ inch larger than diameter of screw at bottom of thread. This, as is evident, will allow $\frac{1}{100}$ inch at top and $\frac{1}{100}$ inch at bottom which is clearance or take-up, which obviously can be of but doubtful value in all cases, as the take-up can only be made by closing the nut from opposite sides.

Another thing, as stated in my paper, screws will vary in diameter as widely as their pitches, consequently tap drills will vary in diameter for different pitches on the same diameter of screw, consequently the plea for uniform tap drills can have but little weight.

To sum up: The fact that the depth of the screw in my computations is always $\frac{1}{2}$ + pitch (No. threads to 1 inch) as in the square thread which it is proposed to replace, and is always in figures readily measured, makes it, in my opinion, of much more practical value than the "proposed new standard screw thread" whose depth is in decimals to the $\frac{10}{1000}$ place, which you have lately published, giving *me* the credit "for taking considerable interest and made computations." I think I have done more. I have devised a screw thread, have made experiments, and have actually used the same nearly a year to test its value, and I have proved not only to my own but to others' satisfaction, this to be the correct form of thread to replace the square thread as well as all others commonly called "bastard."

There can be but few gauges made for this thread, and future gauges can be made to conform to the depth $= \frac{1}{2} \div P$ by grinding off $\frac{1}{100}$ inch from the cutters used in making these gauges. I had hoped to have seen Brown & Sharpe and to have tried to convince them of their error, and to have had the matter right before it was placed before the public.

I trust that my position will be sustained and the thread in its original dimensions adopted. Then if others wish to claim the glory they can have it. I only want to have the simplest, easiest to construct and correct form to be adopted in case it is desired or deemed wise to replace the old familiar square thread. Don't make the mistake of trying to force a new thing on the public if it requires any more skill to make than the old, and, especially, in the case of this so-called "acme screw," which necessitates considerable mathematics to understand.

A. M. Powell,
B. S., Mech. Eng.,
President The Powell Planer Co., Worcester, Mass.

Computing the Horse-power of a Steam Engine.

Editor American Machinist:

I notice in the American Machinist, December 20th, Mr. William Cox's "New Calculating Device," applying to the computation of the horse-power of a steam engine. This little operation occurs to me quite frequently to do either for a steam engine or an air compressor, the operation being the same in either case, and the best labor-saving device that I have found for it is just common, every-day arithmetic. Mr. Cox gives a simple example:

Diameter 8 inches, stroke 12 inches, pressure 40 pounds, revolutions 100, required the horse-power. The entire figures that I find it necessary to make in this case, except the one multiplication indicated, are as follows:

$$8^2 \times .7854 \times 40 \times 200 \div 33000 =$$
$$.000.0238 \times 512 = 12.1856.$$

Here I have all the materials of the job before me, so that I may be sure that none of them get away, and my answer is absolutely correct and complete for the data, while Mr. Cox's result is not absolutely correct "to five figures," nor to one figure beyond the decimal point. Does anyone advise me to go puttering with a slide rule, or hunting a figure to be taken upon trust from a table or locating a position upon a logarithmic chart? All these devices have their value in their place, and in some cases are indispensable, but in this case they seem to cost rather more than they are worth.

My solution above is easily understood. Every engineer apparently does not know that .7854 ÷ 33,000 = .0000238, dividing without a remainder. If this figure .0000238 is remembered, the remainder of the operation is easy. We cross out the .7854 and the 33,000, taking the .0000238 in their place; then in any case any ciphers on the right-hand of any remaining factor will each knock out one from the left-hand of our constant, .0000238, and as we have three such ciphers at our disposal, the .0000238 becomes .0238. The 512 is the product of the remaining factors 8^3, 4, 2.

I offer a second example: Diameter 40 inches, piston speed 300, pressure 45, required the horse-power. By my method this would look like this:

$$\frac{720}{40^2 \times .7854 \times 45 \times 300 \div 33000} =$$
$$2.38 \times 216 = 514.08.$$

Here I first multiply $45 \times 4^3 = 720$, getting rid of one factor and getting another cipher to cancel with. As we have five ciphers, two in the 10^3 at the left, the .0000238 becomes 2.38, and the 216 is, of course, the product of the surviving factors, $72 \times 3 = 216$. By Mr. Cox's formula the above would be:

$$\frac{300 \times 45}{26.3} = 513.308,$$

the 26.3 being hunted up from a table and the result, 513.308, not being absolutely correct for the data as mine is.

Frank Richards.

Command of Naval Vessels.

Editor American Machinist:

I must express my surprise at the mildness and charity with which you refer to the communication of "Forecastle" in your issue of December 6th. It is deserving of much greater censure than you saw fit to give it. It is entirely characteristic of that unfortunately too numerous class of line officers of the navy who never write or descant in any way on the subject contained therein without an exhibition of that reprehensible animus with which they seem to be imbued where engineers are concerned.

The writer of the communication in question professes to have been only an ordinary seaman. If he were, believe me, there is somewhere concealed under that "Forecastle" one of that particular quality of officers of the line who can never quite see the propriety or necessity of treating an engineer fairly. "Forecastle" says that after three years' experience with them he has no hesitation in saying that the regular line officers of the U. S. Navy are gentlemen, etc. He makes no exceptions. The writer has made the acquaintance of many and served under some (during eight years' service in the engineer corps) than whom nature could not produce more perfect specimens of American manhood; *they were* gentlemen with all that the term implies; but they were not of that McAllisterian 400 who make all the trouble between the line and staff; and unfortunately for such of them as exhibit the animus complained

of, the former are precisely those of the line who never have any trouble with engineers, or any one else of any consequence under their command.

But "Forecastle" only sets up that same old man of straw. Who among engineers have ever contended that captains should not command naval vessels and everybody thereon? And it is simply begging the question to name such a proposition. It used to be said when the writer was in the service, as illustrative of the imperative necessity for discipline, that if the captain should order a man, during a howling storm, to jump overboard, it was his duty to jump. Now, the supposed order of Commander Thomas T. Stevens to one of his junior engineers then on watch, if ever given as stated (which I will be charitable enough to the said commander to flatly doubt) was not a whit better than the traditional order referred to; and if it exhibited anything better than pure cussedness on the part of that commander it was his utter incapacity to command either ship or men.

The gist of the matter is that, no matter how completely a captain should be in command of a ship (and his command should be complete and unquestioned) he is not at liberty, nor is he authorized by any regulation or requirement of such command to give orders which are palpably improper and indefensible, or, as in the case the writer cited in a former communication, impossible of execution. Nor is a commander, however much it may be iterated and reiterated, held responsible for shortcomings of his subordinates; this little fiction has been done to death, and there is no semblance of truth in it. He might have ordered the engineer to draw a half dozen tubes out of the boiler to increase the draught (and this is quite as sensible as some orders I have known given) or a thousand and one others no less absurd, which no engineer would obey if he could.

If the engineer of the "Sonoma," in obedience to orders to carry 60 pounds of steam in a boiler in which the chief engineer's previous orders had placed the safe limit at 45 pounds (and if the chief engineer did not know the maximum safe pressure, how did the commander find it out?) had blown out a few of the tubes or otherwise disabled the boilers, so as to defeat the object in view—that of overhauling the "Florida"—no word would ever have been heard of it, and "Forecastle" would have been saved the trouble of putting his friends on record. Perhaps an engineer or fireman or so might have failed to save "his own precious carcass," which, of course, to such people would have been of little consequence.

As I have said above, I shall take the impolite liberty of doubting that Commander Stevens ever sent such an order in the way described, although I was not acquainted with him while in service. If he did, however, I think that he deserved to have a marine stationed over him for the rest of his official life, with imperative orders to shoot if he ever opened his mouth.

The animus of "Forecastle's" letter, and its real origin is, however, nowhere more clearly shown than in the silly sneer at the young engineer's supposed solicitude for "his own precious carcass." Engineers were not often accused of lack of personal bravery during the war, and when we find a supposed ordinary seaman (who in the nature of things could know nothing about it) or some line officer over his shoulder, attempting in so small a way to disparage them in this respect they do engineers no harm, and their own cause little else. If I could command your space I would like to tell of an episode or two of the war in which the personal intrepidity of engineers appeared in strong contrast and infinite favor as compared with some of their confreres of the line on those occasions, and perhaps I may some day with your kind consent.

The proper course of the commander of the "Sonoma" under the circumstances would have been to consult with his chief engineer—instead of sending any orders whatever to a subordinate on watch already under orders—as to the urgency of all possible speed being gotten and held, instead of sending a disgraceful and disgracing verbal order over his head to a subordinate officer on watch by a man before the mast.

A self-respecting engineer would have done everything in his power to carry out the captain's wishes.

The chief engineer was the man who was educated, equipped and placed there to know what was the highest allowable pressure to carry in his boilers, and the captain could have had his co-operation in gaining his object if he had merely kept within his own prerogatives, but the great trouble is that these people love to believe that when placed in command of a ship they thereby become little monarchs whose despotic power is without limit, and very little ones some of them do become.

Taunton, Mass. JOHN T. HAWKINS,
Late Passed Asst. Engineer U. S. N.

The Co-operative Contract System.

Editor American Machinist:

The co-operative contract system described by Mr. Richards is very interesting, as showing practical examples of co-operation by skillful, intelligent and *selected* workmen, but it will not, and by the nature of it, cannot be of any extended use as a remedy for strikes. The very tap-root of labor difficulties is the question of profit. Workmen strike for more wages because they think they are not getting a fair share of the profits on what their labor produces. There are two factors which are the chief things that cause the men to reach this conclusion: First, they find they are paid a less rate than is being paid for similar labor elsewhere; second, they see by their employers' expenditures that a remarkably large profit is being yielded by the business that employs them. There are other things that sometimes cause a strike, but they are so rare that it is not necessary to consider them.

In the co-operative contract system described, the workmen co-operate in fixing the relative value of each man's skill or ability at his share of the work, but otherwise it is the time system of paying in which each man is paid in proportion to the time he has worked on each contract. The men also co-operate to watch each other, and if any one of them is found scamping his work or shirking his share of the labor, he is discharged. The result is a rigid selection of honorable and efficient men, particularly fitted for this peculiar style of co-operation. The actual rate of wages is determined by the condition of trade in the articles produced, and the *profit* the employer thinks he ought to have.

When the employer makes up the estimate of the labor, materials, expenses and profits, and finds on comparing with prices of such articles made by others, that his price is too high, the first thing he does is to see where he can cut it down. If he is a humane and reasonable man, he will cut down the profit item to its lowest possible point, and yet include risks, and will figure the materials and other expenses as low as possible; then if more is needed, take it off the wages as the final item. Having done this no more can be expected of him, and if the workmen are aware of the state of the case, and have common sense, there will be no strike. Now, suppose instead of this he is an employer intent on making an inordinate profit, and he concludes to cut it all off the wages item, as he has a perfect right to do, for Mr. Richards says the workmen are to have nothing to say about the profits. Here we have the tap-root of labor troubles and first-class conditions to cause a strike, notwithstanding the apparently perfectly organized co-operative system. The difference between the ordinary time pay system and this co-operative plan is, that the men relieve the employer of the difficult responsibility of fixing the relative labor value of his workmen, and of watching them to see that they do not shirk. What induces them to take this duty upon themselves is the fact that they will save time on the contract, and thus get the same money for less time spent in doing the contracted work.

Take the same employer and the same set of men, and there is no reason why they would not get on just as well and make as good or better wages on the individual piecework plan, where the men would not need to watch each other to see if they were shirking. The fact that the co-operative contract system is in successful operation in several places is not proof that it is the result of the system. It only shows that there has been collected together a lot of sensible and reasonable men who are honest enough to co-operate in their work, and are fortunate enough to have employers who are satisfied with a reasonable profit. The real and effective co-operation in such cases is that of the men with the employer. Take the same men and put them in the hands of an unscrupulous employer, and the co-operative feature would vanish in an exceedingly short time.

There are thousands of employers who pay entirely by the time system who have never had any strikes or labor troubles of any kind, yet this does not prove that the time system is without fault and cannot be improved. It only proves that on the one hand there are reasonable and sensible workmen, and on the other an employer who is satisfied with a reasonable profit and who takes a genuine interest in the welfare of his workmen.

No observant and candid person will deny that the time pay system is imperfect, but the fact that it is still in so extensive use, simply shows that human nature is not collectively far enough advanced to permit the general use of a better system. The piecework plan is the only one which entirely eliminates the time factor and pays only for the quantity and quality of labor expended.

It is still a question whether it would be best for social conditions to make a rigid and universal application of this plan of paying labor. But for the present this will be ignored, and we will admit that the piecework system is the ideal condition we wish to attain.

This system has already been adopted in many industries, the most notable being the manufacture of iron and steel, which is paid by the ton. Coal mining is paid the same way. Train employes on many railroads are paid at a fixed rate per trip over a given route. But this system has been tried in many places and proved a failure. Where it fails, the workmen and the employer are generally about equally responsible for its failure. A few selfish and greedy workmen think they will make hay while the sun shines, regardless of future consequences, and they go into a fierce competition with time to make all the wages possible. The proprietor soon begins to think that these workmen are getting most of the profit there is in the business, and he cuts down the price per piece. The men then strive to make as much per day as before, and when they do this the proprietor reduces again. This process is repeated until the men find themselves working like slaves for wages that afford only a bare living. The selfish workmen, after skimming the cream off, have left the shop, and the remaining ones suffer the effects. If the workmen had been a lot of intelligent, skillful and *selected* men, who had human interest and enough sense of justice to co-operate and prevent disastrous competition among themselves, and were fortunate in having an employer who was satisfied with reasonable profits, there is no reason why the piecework system would not be as successful in operation as the co-operative contract system, or the time pay system, with the same workmen and employer. All you need to do is to look in the right places, and you will see entirely successful examples of both time pay and piecework systems.

I am glad to say there are honest and conscientious workmen, and employers who honestly desire to deal fairly with them, and I have the highest respect for, and wish the greatest honor to, those employers who, by profit sharing, gain sharing, or other plans, are trying to give labor an equitable share of what it helps to produce, for I think they are about the only ones who are doing anything practical toward solving the labor problem. But, Mr. Editor, if they were the only kind of employers involved in the question there would be no labor problem.

Although it may be very unpleasant to have to say so, the fact is the modern labor problem cannot be intelligently discussed without taking in consideration that other kind of employer represented by the great industrial millionaires and corporations who do absolutely nothing toward solving the modern labor problem, and who apparently give no attention to it except when it is forced on them by a strike. When they anticipate labor troubles the great industrial kings hie themselves away to foreign shores, or go on a pleasure trip around the world in a luxurious yacht, and leave their managers, who are hired on the time pay plan at so much per year, to fight it out with the assistance of private police, sheriffs, State militia or the regular army. The laboring classes naturally are making the greatest outcry about it all, because they suffer the worst in the struggle.

The laboring classes have made serious mistakes in attempting to remedy their wrongs by resort to force, but considering their limited education and opportunities they are no more to blame than are the more educated and enlightened employers who secretly employ armed forces to carry their plans through, instead of employing the more sensible and judicious plan of patience and legal injunctions.

The only solution of the labor problem that seems universal in application and results, is by co-operation. For industries of moderate proportions co-operative societies of workmen will be the plan of work, and for large systems of a public character like the post office, railroads, telegraph, telephone and similar service it will be co-operation of the whole public in the shape of government control. The frequent failures of co-operative enterprises show that it takes more knowledge and a higher sense of justice than has yet been attained, before it can become universal, and in the meantime such discussions as this, conducted in the proper spirit, will do something to help us all to a better knowledge of the problem before us.

Finally, I will say without any fear of proof to the contrary, that no system however much exploited, or however often it may be tried, can prevent strikes or help solve the labor problem, if it is offered to labor only on condition that laborers are to have nothing to say about the amount or disposal of the profit that capital is to get from the product of their labor.

BELL CRANK.

The "Three-crank Mechanism."

Editor American Machinist:

The interesting discussion by Mr. Leicester Allen and Prof. F. L. O. Wadsworth, in a recent issue of the AMERICAN MACHINIST (November 8th), page 3, Figs. 1–5, concerning the invention and application of the "three-crank mechanism," and references to its origin, prompts me to add a few words.

In the Mechanical Engineering Cabinet of Models of the Ohio State University there is a well-designed and complete working model in metal of this movement, the drawings for which were made some five or six years ago.

This mechanism is fully illustrated and described on page 190, of F. Reuleaux' "Kinematics of Machinery," edition of 1876; also on page 206 of Professor Willis' "Principles of Mechanism," edition of 1870, and on page 246 of Laboulaye's "*Traité de Cinématique*," edition of 1861. From statements made in the two books last mentioned, I am led to believe that a description of this motion will be found either in Laboulaye, edition of 1849, or in Willis, edition of 1838, neither of which are accessible to me at this writing.

Thus the quotation of Mr. Allen seems further verified, viz.: "It hath been already of old time which was before us."

Columbus, Ohio. S. W. ROBINSON.

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Erie Canal Improvement.

Enthusiasm in regard to canal improvements, such as aided to fill the columns of the daily and technical press about a year ago, has borne no fruit as yet, and there is every prospect that the ubiquitous mule will for the coming season, at least, continue as the motive power on that strip of raging water between Albany and Buffalo.

The scheme of driving the boats by screw propellers, turned by electric motors, which were to gather the electricity from a trolley wire, seems to have fallen through completely since experiment demonstrated to those fathering the project that the great loss of efficiency with full lines and shallow draught—even ignoring the first cost of refitting the boats—overbalanced any supposed advantages in that means of transport, and haulage systems, such as cables and tracks on the tow-paths, seem about the only favored rival of present methods.

While the talked-of deepening of the channel would be a great benefit to the boatmen, yet the money, if put into a cable system having tracks for traveling clutches, by means of which a boat could depend upon a speed of not less than four miles per hour, would be the means of placing the canalers on a footing of prosperity that they have not enjoyed since the earliest days of the Erie.

Under the present system, single boats are absolutely unable to live as through freighters, and even double-headers are forced to whip and urge their overworked animals, in order to make trips enough to cover bare expenses.

The only paying boats are those driven by steam, which take several of the regular type through to New York lashed together, and so cut down the costs of operation.

But such steam fleets require considerable capital to build and operate, and this very few ordinary boatmen are able to command.

The canal being 352 miles in length, a steam fleet which makes about 2¼ miles per hour requires on an average 7¼ days to steam between Buffalo and Albany. This gives 5.82 days for actual running, and 1.43 days for delay incident to "locking," etc.

The total round trip, Buffalo to New York and return, can be made by such a fleet in 30 days, giving time to lie over at both places when a cargo is not immediately on hand for shipment.

This speed allows seven round trips per season, barring accidents, and with wheat at 4 cents per bushel a fair profit can be made by the owners.

But for double-header horse boats seven trips *must* be made to reap an actual profit, and the speed being much less on the canal, there is no margin for lying in port to await cargo. If return freight is not ready at New York, the boat must run back to Buffalo "light," during wheat shipments, and the consequence is a loss for the season, even with rates at 4 cents per bushel.

The average freight for 1891 was 3.49 cents per bushel of wheat, and this would entail a dead loss, even allowing full easterly cargoes, and the usual return loads.

If even the double headers are to continue, more trips must be made, and the speed on the canal proper must be increased to meet the new demand, as the river and harbor portion of the cruise can hardly be changed.

At 4 miles per hour, single boats, which are now unable to live, can again make money, even on 3½ cents per bushel carried.

The steam fleets running at 2½ miles per hour are 14½ days on the canal for the round trip, which, as before stated, can be made in 30 days with all allowance for delay. Of these 14½ days 11.64 are consumed in actual steaming, while 2.86 are for passing through the locks.

Double headers as well as single horse boats are towed between Albany and New York, and after leaving the canal make about the same time as the steam fleets. At 4 miles per hour the 11.64 days would be cut down to 7.275 for running—a saving of 4.365 days per round trip—which reduces a month's travel to 25.635 days, and an ordinary boat could thus make eight trips with the same end waits as now taken by steamers making but seven.

A single 250-ton boat, costing $3,500 complete for service, and carrying a captain and two deck hands, can pay all expenses, and have a surplus of several hundred dollars besides, with wheat at 3½ cents per bushel, if making eight trips per season, as can be done by speeding up to 4 miles per hour on the canal alone, and the increase of traffic that would follow the bettered condition of affairs, would still further swell the purses of the boatmen.

It is to be hoped that political administration of the Erie, to which is mainly due the present unsatisfactory condition of the waterway, will not be countenanced in future, and that men will be placed in charge of any improvements that may be inaugurated who are competent to supervise the work, and who will make it both an engineering and a commercial success.

With a proper haulage system owned by the commonwealth, the charges for power should be comparatively light, and the class for whose benefit the canals were originally built, would again be able to stand out against the moneyed interests that now control transportation through the State.

Voting Machinery.

The mechanical recording of the ballot at elections, by devices such as are now attracting earnest attention, is an innovation that is calculated to purify the public service, in so far as such is affected by the intimidation of voters and the time-honored custom of juggling with the returns.

The voice of the "heeler" is no longer to disturb the citizen, and the "striker" already wears the far-off look of one in search of fresh fields and pastures new.

There yet remains to be constructed a nominating mechanism; something that will automatically cancel the names of citizens anxious to serve their country, unless their records be such as renders it logically certain that their wish to suffer the honors and emoluments of office, springs from an inborn desire to further the public interests.

Before we finally adopt these new devices it might be a wise move, financially, to issue detailed descriptions for foreign circulation in order that there may be no misconception on the part of citizens of the effete monarchies.

These worthy but misguided persons, whose training has unfitted them for understandingly following the rapid advances of their less conservative brethren, have lately taken to withdrawing their funds from American railroads, a spirit of uneasiness being said to prevail in Europe, in regard to what is looked upon as revolutionary behavior on the part of railroad officers in the States. And in view of the well-known close relations of railroad and State officials, the seeming sudden entire change of front of our people in regard to "machine" politics—against which such denunciatory language was used but a few months ago—may have something to do with the prevailing desire of our best customers to draw their gold in haste from Yankee securities.

But, speaking seriously, the Meyers voting machine, which just now is attracting most attention, seems perfectly adapted to the work of eliminating from elections a very large proportion of the most objectionable, not to say dangerous, features of our elections. In other words, the machinist seems likely to furnish to society something which will enable the citizen to express by his vote his real choice of men and measures, and to have that vote certainly counted—a thing which is of vital importance.

In addition to this, the machine also seems able to do what most other machines do when compared with manual labor—reduce the cost of the work. This it does by doing away with printed ballots, and in saving time, and, therefore, a portion of the expenses of polling places. We think very highly of this latest achievement of the machinist, and think the day will come when it will be recognized as one of the greatest blessings ever conferred by him, because all else is of little use unless we can preserve the purity of elections, and thus have a real government by and for the people.

It has been decided in the U. S. Supreme Court that the statute of limitations applies to claims growing out of patents the same as to other claims.

Literary Notes.

THE REPAIR AND MAINTENANCE OF MACHINERY. A Handbook of Practical Notes and Memoranda for Engineers and Machine Users. By Thomas Walter Barber, C. E., M. E., Author of the Engineer's Sketch Book, etc.

This book treats of repairs to general machinery. The author points out faults to be found in some machines, some of which were brought under his notice and remedies suggested. In this part of the work the reader will find many useful hints. On the other hand, some of the tables given in the book are not satisfactory—they are ambiguous; for instance, in the table of horse-powers of boilers, the nominal horse-power is given, without stating the value of this power. Many boiler makers adopt a nominal horse-power of their own, differing from others, so that the term nominal horse-power without qualifications is meaningless, and should not be used. In fact, most engineers consider this term obsolete. The table giving the horse-power transmitted by leather belts would have been far more satisfactory if the rule had been given by which it is calculated. In our opinion, the powers are too high. We presume that this table refers to belts running over pulleys of equal diameters, although this is not stated. The cuts giving the general appearance of the different machines treated are fair, but many of the diagrams used in an explanatory way in connection with the text are decidedly bad.

The book is published by Spon & Chamberlain, 12 Cortlandt street, New York. Price, $3.50.

We have received from H. V. & H. W. Poor, New York, a copy of "Poor's Directory of Railway Officials and Manual of American Street Railways." The title of this book is sufficiently indicative of its character, and the book will be found indispensable to those who have business relations with railway officials. We believe it to be quite complete and accurate.

We have received from the Commissioner of Labor, Carroll D. Wright, Washington, D. C., a copy of the "Ninth Annual Report of the Commissioner of Labor," which is devoted to building and loan associations. It contains a vast amount of statistical and other information regarding such associations, and will be found of value to all who are interested in them.

We have received a copy of the book called "Furnace Work Manual," an exposition of furnace work in all its branches, compiled from the files of the "American Artisan," by Sidney P. Johnston. This book is not devoted, as our readers might infer, to a description of the construction and handling of industrial furnaces, but to such furnaces as are used for heating dwelling houses and other buildings. It gives a great deal of valuable information regarding their construction and installation, and for the laying out of connections to them.

We have received from the Syracuse Twist Drill Co., Syracuse, N. Y., a calendar which is small enough to be neat and to go into a desk or the cover of a machinist's tool chest or other limited space, while at the same time its figures are large enough to be distinctly seen. It is a model, and the above named company write us that they will be glad to send it to any reader of the AMERICAN MACHINIST upon receipt of address.

QUESTIONS AND ANSWERS.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet. We cannot undertake to answer questions in "next issue." This department is usually crowded, and questions must wait their turn to be answered. Neither can we undertake to solve mechanical or engineering problems, and send answers by mail.

(31) A. B., ——, asks: What is the standard taper for steam and water cocks? *A.*—We are not aware that a standard taper for this class of work has been established. A prominent manufacturer of steam and water fittings, etc., uses a taper of ¼ inch per inch. Other manufacturers may use a taper differing slightly from the above.

(32) W. F. G., Warsaw, Ind., writes: Why is the center of gravity of the weighted lever used in solving problems on safety valves? *A.*—The product of the weight of the actual lever into the distance between fulcrum and center of gravity is equal to the product of a simple equal weight into the given distance taken as a lever arm, and affects the safety valve in the same way as such ideal simple weight and lever.

(33) A. D. H., Atlanta, Ga., writes: Please give me a little information in regard to overshot water wheels. I want to build one 2½ feet diameter and about 4-inch face. What I want to know is the pitch and the number of buckets for this size of wheel. *A.*—We should use seven buckets, and the pitch equal to an angle of 120 degrees, with the radial line drawn to the inner edge of the bucket.

(34) G. F., City, writes: How can a piston working in a cylinder, one end of which is open to the atmosphere, be made perfectly tight to maintain a high vacuum on the inner side? *A.*—A deep piston accurately fitted to the cylinder, and having shallow grooves or scores, and in addition two packing rings, the slots of which break joint in addition to being tongued, make a good job, although not *perfectly* tight. If the piston is to move slowly, the ordinary hemp packing will probably be the best, especially for a small cylinder not of the very best workmanship.

(35) A. N. J., Manistee, Mich., asks: Which paper contains notices of new buildings contemplated or in course of erection, and which paper contains advertisements for bids for government buildings? *A.*—In our columns headed "Manufactures," you will find much that will interest you. Newsdealers generally keep on hand all first-class technical papers; we would prefer to have you examine these and make your own selection. 2. Which number of your paper contains instructions on making blue prints? *A.*—See answer to Question 120, in our issue of March 8, 1894.

(36) L. R. S., Chicago, Ill., writes: Kindly advise me of the best method of electroplating copper, nickel or silver. I intend to do plating, and wish to get the best and simplest method for doing the work good. *A.*—There is so much to be said on this subject that space prevents us to go into this matter in detail, as should be done. Since you intend to go into this business, we should advise you to get the "Complete Treatise on the Electro-deposition of Metals," by Dr. George Langbein, published by Henry Carey Baird & Co., Philadelphia, Pa. This is one of the best books treating on the subject, and will aid you much in the theoretical and practical branches of the work.

(37) A. G. L., Cornwall, N. Y., writes: I wish to build a boiler of the porcupine type, and I intend using tubes 1 inch diameter, and welding up their outer ends. Is it necessary to have for circulation a smaller tube inside of each one of these 1-inch tubes reaching to within an inch of the end? *A.*—No. 2. Will the 1-inch tubes screwed into the stand pipe answer the purpose, and is 12 inches too long for this size of tube? *A.*—Unless the boiler is very small, we prefer tubes of larger diameter, say, not less than 1¼ inches, and then expand the tubes in the stand pipe. Cutting a thread on the tubes may weaken them too much, and give considerable trouble. A length of 12 inches for 1-inch tubes is not too great.

(38) X. Y. Z., Petaluma, Cal., writes: Please answer the following: Please name the best paint for a smoke stack to prevent rust. We now use coal tar, but it does not last very long. *A.*—Ground graphite mixed with the coal tar and the mixture thinned with turpentine may give you better results. Dixon's graphite paint has a good reputation. 2. Should gears work with the teeth lubricated or should they run dry? We always grease all gears, and we know they run more quietly than when dry, but we have heard others argue that if run without oil they will run as long and easier. *A.*—Gears which transmit power should have the teeth lubricated; gears which transmit very little power, or practically transmit no power, should run without lubricating the teeth. For instance, the back gears of a lathe should be lubricated, but the teeth of the change gears should run with the teeth dry.

(39) J. S., Indianapolis, Ind., writes: My knowledge about the metals used in machinery is not very complete. I therefore ask you to name the title of a book treating on this subject. I would like to learn more particularly about the chemical and physical properties of iron and steel, also about the meaning of mild steel, flange steel, Bessemer, crucible, and open hearth steel, etc., and why for a certain structure or for a part of a machine a particular kind of steel is used as steam boilers, shafts, pins, connecting rods, etc. I should also like to learn more about annealing, hardening and tempering. *A.*—The book entitled "The Metallurgy of Steel," by H. M. Howe, and published by the Scientific Publishing Co., 27 Park Place, New York, treats on the chemical and physical properties of iron and steel, annealing, tempering, etc. It is probably the most complete work published on these subjects. The choice of iron or steel for details of machinery depends much on the duty or the character of the work each piece has to do, and the form of the piece. Sometimes the selection of the material is influenced by the contract price of the machine. On the whole, experience is probably the best guide for the proper selection of material.

(40) R., Philadelphia, writes: We frequently have in our shop a number of pieces of cast round steel ranging from ⅛ inch to 1 inch in diameter, and 4 inches long, to have holes from ¼ inch to ½ inch drilled through the center the entire length; these we have always drilled with a flat drill, but find it slow and unsatisfactory; the difficulty of keeping twist drills central, and their shortness in the smaller sizes prevented their use, and so we apply to you, hoping for a more satisfactory way of proceeding; the steel used is generally either Howe, Brown & Co.'s, or Jessop's, well annealed. *A.*—We doubt our ability to suggest anything which will be helpful in this case, as it is, of course, apparent that the man who is doing the work is best acquainted with the conditions under which it must be done, that is, its cost, the degree of accuracy required, etc. If sufficient numbers of them are to be drilled to make it worth while, perhaps the modern method of drilling such as is used at the Pratt & Whitney Co.'s, or at the Bridgeport Machine Tool Works, where a drill is used which has a tube laid in grooves cut in a drill, and oil is supplied under pressure to the point of the drill, would be the best method. Very good results are obtained by this process, but we doubt its adaptability to the smaller sizes of holes mentioned by you.

(41) B. U. C., Lockport, N. Y., writes: Please inform me which of the two designs of a D-slide valve is the best. The difference between the designs is simply this, one valve works on a flat valve seat, and the other works on a circular valve seat. I have built several small engines with the latter valve, and all have worked very nicely; but this design has been severely criticised by older mechanics in this locality. I leave this matter for you to decide. I claim that the valve working on the circular seat is the best, as there is less steam pressure on a valve of this kind for the same size of steam port openings, than there is on a valve working on a flat seat. *A.*—The circular seat will not wear as evenly as the flat seat, and it requires more time to make a true circular surface than a true flat surface. Your sketch also shows that the former surface is not as accessible as the latter, which is another objection when the valve seat has to be trued up. We cannot see on what basis you can claim that there is less pressure on one valve than on the other; if correctly designed the cross-sectional area of the steam passages must be the same in both cases, consequently the projected areas of the valves must also be equal, or very nearly so, and therefore the total steam pressure on one valve must be practically equal to that on the other. That a flat valve seat is the best is seen by its popularity.

(42) A. H., Natchez, Miss., writes: What is the difference between the friction in a 5-inch pipe, and in one of 6 inches diameter? *A.*—The effects of friction will be practically inversely as the hydraulic mean depths *for the same velocity* of flow. This is found by dividing the area of the pipe by the wetted perimeter, or here—the pipe flowing full—the area by the circumference, which for round tubes gives always $\frac{r}{2}$, or half the radius. The greatest value is for the larger pipe, so that its friction is less than that of the smaller, or $\frac{1.25}{1.5} = 0.833$ of the friction of the small pipe. But if the *same volume* of steam is to pass through, the velocity is greatest in the small pipe, and the resistance being directly as the square of the velocity, the large pipe has still more advantage. Taking the resistance of the small pipe as 1 for comparison, the large tube resistance would be $1 \times 0.833 \times \frac{3^2}{5^2} = 0.54$, or about half that of the 5-inch pipe. If the velocity in pipe is not over 100 feet per second, the resistance can be neglected, being very small, but for a greater flow Rankine's simple formula can be applied. Calling P the initial pressure in boiler, and P' the pressure at the opposite end of pipe,

$$P' = P\left(1 - \frac{v^2}{180\ T}\right)$$ where v^2 is the square of the velocity of flow in feet per second, and T the temperature of the steam plus 461.2 degrees (or 460 degrees is near enough).

(43) F. J. M., Oakland, Cal., writes: We have a boiler with a conical flue, which is made in two courses, the course of the large diameter is made of steel plate $\frac{7}{16}$ inch thick and is 63 inches long. The course of the small diameter is made of steel plate $\frac{5}{16}$ inch thick and is 32 inches long. The large end of the flue when finished is 30 inches diameter, and the small end is 15 inches diameter. I would like to know the collapsing pressure of this flue and the weakest point in its length. *A.*—The flue being comparatively short and large in diameter, with a liberal thickness of metal, there is not much danger of the flue collapsing, but it will fail by crushing the metal; hence the following formula based on the crushing strength may be applied:

$$p = 12{,}000 \times \frac{t}{d},$$

in which p = working pressure per square inch, t = thickness of metal in inches, and d = the large diameter in inches of each course. The large diameter of the long course is 30 inches, the thickness of the metal is $\frac{7}{16} = .437$ inch, substituting these values for the letters in the formula, we have

$$p = 12{,}000 \times \frac{.437}{30} = 132 \text{ pounds}$$

per square inch. The large diameter of the short course is 20 inches, the thickness of the metal is $\frac{5}{16} = .312$ inch; this gives us

$$p = 12{,}000 \times \frac{.312}{20} = 180 \text{ pounds}$$

per square inch. Taking into account the additional strength which the flue receives at the ends by riveting it to the flue heads, we should say that the center of flue is probably the weakest part. The constant of 12,000 is used in the above formula when the length of the flue or course is 290 times the thickness; when the length is 430 times the thickness then use 8,000 in place of 12,000, and when the length is 580 times the thickness use 6,000.

(44) P. L., Fitchburg, Mass., writes: In your answer to Question 535 in your issue of November 15, 1894, you say:

"$v = \sqrt{2 \times 514.29 \times 2} = 45.3$;

momentum $= m \times v = 24.9 \times 45.3 = 1{,}123$ foot-pounds, etc." I cannot see it in this way. I understand the momentum to be the product of the mass and the velocity; or, in other words, if the body is acted upon by gravitation in a free fall, to be the product of the weight of the body and the time in seconds during which gravity is acting upon the body, which in numerical value is equal to the final velocity of the body multiplied by the mass of the same body; but I cannot understand how to get foot-pounds out of it, as, in fact, if reduced to a gravitation problem, it is the product of time in seconds and weight in pounds. If I should find the kinetic I would use the formula $\frac{1}{2}\ m\ v^2$, which, if reduced to a gravitation problem, would be the product of the weight of the body and the hight through which it is falling under the action of the force of gravity. For this steam hammer it would be $\frac{1}{2}\ m\ v^2 = \frac{24.8}{2} \times 45.3^2 = 12.4 \times 2052.09$ = 2,544.82 foot-pounds as the stored-up energy in the hammer, but this energy cannot be used in calculating the force of the blow of the hammer in pounds, unless we know how far the hammer would penetrate the body it strikes on. Thus I see, of course, the result of your calculation is the right answer, but what I wish to know is: Can the term foot-pounds be correctly used in the sense it is used in explaining the answer to Question 535? *A.*—The unit of momentum is the momentum of a unit of mass, moving with a unit of velocity. To this unit no particular name has been given. In answering the question above referred to, we inadvertently had in mind the stored-up energy of a body, and used the expression, "here we have a stored-up energy of 1,123 foot-pounds," which we should not have used, as it gives rise to some ambiguity. This, however, will not change the principle involved, nor change the explanation given; the answer, otherwise, is correct.

BUSINESS SPECIALS

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A New Screw Thread.

We print below a paper by A. M. Powell, B. Sc., Mechanical Engineer and President of the Powell Planer Co. This paper is referred to elsewhere in this issue in a letter from Mr. Powell, and is as follows:

A NEW SCREW THREAD.

Mr. President and Gentlemen of the Society:

I wish to call your attention this evening to a new screw thread I have designed, which is proposed to replace the square form of screw thread, having none of the faults, but all of the advantages of the square thread, but unique in itself of much greater value.

The chief and, in fact, only real advantage in the square thread in itself is in the fact that the line of thrust is parallel to the axis of the screw, consequently the friction being so much less than in angular threads, it is used for lifting purposes or in the movement of parts of machines requiring continuous or reciprocal motion where a minimum frictional resistance must be an important factor. This appears to me to be the only feature which should commend itself at any time to the mind of a progressive engineer and designer in machine construction.

The fact that there is great difficulty in making proper fits, and the entire lack of provision for "take-up" in case of wear should cause it to be cast aside by the practical mechanic. Another thing, in cutting a square thread screw, especially in cases where the thread is multiplied (or split as it is commonly known in shop parlance), the clearance of the cutting tool must be so great as to not only materially weaken the tool, but at the same time seriously question the accuracy of the finished thread itself. For the same reason (viz., the clearance of the cutting tool) it is impossible to cut this form of thread to advantage with a die plate, or in a bolt cutter, and since the bolt cutter has made such

rapid strides to the front as a great labor-saving tool in the machine shop, it has become imperative that a new form of screw thread should be devised meeting all these requirements, having substantially all the valuable features of the square thread and none of its faults or disadvantages—a screw thread which would commend itself and be accepted as a standard in the mechanical world.

To this end, at the earnest solicitation of a prominent builder of bolt and screw machinery to devise a form of thread to meet these requirements, I have designed the 29-degree angular screw thread, which I take great pleasure in submitting to this society this evening.

Before proceeding to an explanation of its deduction, allow me to state that the 29-degree angle, which I have used rather than any other, was due to the fact that very exhaustive and satisfactory experiments have been made on angles for worm-gearing threads, and it was found that a worm thread cut at the angle of 29 degrees, and to a certain depth, reduced the frictional resistance between the thread of the worm and the teeth of the wheel the greatest amount.

Gauges have been made for this worm angle, and it has been recognized by the engineering world as the correct form for worm gearing. Again, this angle will give the necessary clearance to the cutting tool in excessive pitches, and will also permit the screw to be cut with a die or bolt cutter. With these facts appealing so strongly I made the angle between the two sides 29 degrees.

Another thing, I appreciated the fact that the new screw would probably be more universally accepted if its construction did not differ materially from the square thread, except in the form of the cutting tool. I use no elaborate and lengthy formulæ, which are apt to mystify and confuse the average workman. I simply make the depth of the thread in every case identically the same as in the square form of thread, viz.: If the pitch is 2 threads to 1 inch the depth of thread is ½ of 1 inch. If the pitch is 4 to 1 inch the depth is ¼ of an inch. In other words, divide ½ by the pitch. (By the pitch we understand the number of threads to 1 inch.)

There is no necessity for using micrometer calipers to measure the depth or tabulated dimension in decimals to puzzle the brain of the workman in devising means to measure the depth. The depth is always one-half divided by the pitch or number of threads to the inch, and is in figures found on the workman's scale which can be readily understood. The width of top of thread is equal to width of space at root, and is determined by the tool-grinding gauge and the workman's calipers as to depth. For other pitches than are on the tool gauge the dimensions can be readily got by the formulæ I will show a little later on. A gauge should be made with one opening of 92 degrees, V-shaped, so as to enable one to grind the tool to proper angle, and then grind off the point of tool to proper width for pitch required as given by the formulæ.

I make no other change in construction of this thread different from what the workman has been used to doing every time he had occasion to cut a square thread. All that is required is to grind his tool to a gauge for the correct pitch, exactly as he does in cutting the Sellers' screw, or even the square thread itself, for that matter. In fact, the only difference is in the form of the sides of the thread. In relation to its construction, I have prepared diagrams which I will now explain. Diagram No. 1 shows the construction of the screw thread. Now, if we take, for example, the proportions of a screw ⅛ pitch in Diagram No. 2, making the distance between point *b* and point *d* in Diagram No. 1 = 6 inches or ⅛ pitch.

From construction $a\,e = 3$ inches,

$e\,b = E\,B = a\,e$ cot. 14° 30′ = 3 cot. 14° 30′ = 11.601 inches, taking depth of thread = ½ ÷ *P* = *M n*.

M N = ½ *b d* = 3 inches, taking this distance away from 11.601 there is left 8.601, of which ½ is above *M N*, and ½ below *M n*, this makes the width of thread at top equal to width of space at root, as is evident. We know that this width of top = *N B* tan. 14° 30′ × 2 which equals 2.2242 = width of space at root.

Again, thickness at root of thread = (3 + 4.3005) tan. 14° 30′ × 2 = 3.7758 inches = width space at top of thread, this added to width of top of thread

$$= \frac{2.2242}{3.7758} = 6 \text{ inches},$$

the distance from center of thread to center of next, which is correct for ⅛ pitch.

From these computations the following formulæ are deduced:

Depth of thread = ½ ÷ Pitch

Width of top of thread } = .3707 ÷ Pitch
" " space at bottom }

Thickness at root of thread } = .6293 ÷ Pitch
Width of space at top }

As before stated, the term pitch is assumed to be the number of threads to the inch.

From these formulæ the exact dimensions of any thread not on the gauge can be accurately easily computed.

I give a table of dimensions for proportions from ½ to 10 pitch.

The valuable features of this new thread making it superior to the square thread, lies not only in its ease of construction, but in the fact of its form admitting adjustments for wear. See Fig. 2, Diagram No. 2.

The diameters of screws will vary as widely as their pitches. A screw may be required in one shop to be $2\frac{1}{16}$ inches diameter, cut 4 pitch double, in another place it might be the same diameter, but cut 3 pitch single, and so on. Consequently we must not look for a standardization of certain pitches for certain diameters with my thread as can be done in the Sellers or so-called U. S. S. system. One fact must be settled on, whatever may be the diameter of the screw, the tap must be made $\frac{3}{100}$ inch larger in diameter, and the thread must be cut with the same tool as is used in cutting the screw, but must be cut $\frac{1}{100}$ inch deeper, making diameter of tap at bottom of thread the same diameter as screw at bottom of thread. This narrows the point of thread on tap .0052 less than point of thread on screw, making the clearance of $\frac{1}{100}$ inch at bottom of nut. The tap drill or the hole bored in nut should be $\frac{2}{100}$ inch larger than diameter of screw at bottom of thread which allows $\frac{1}{100}$ inch clearance between nut and bottom of thread. In Diagram No. 4 I show drawing of tap with dimensions for screw 2 inches diameter, cut 2 pitch, which explains the subject I have just referred to; this screw obviously can be much more easily fitted to the nut than the square thread, and, as has been shown, having clearance (which, understand, is uniform throughout this system) top and bottom allows taking up for wear and back lash in nut. Again, in comparison the two forms of thread, as shown in Diagram No. 5, the further superiority of the new thread at once is seen in and so on. Consequently we must not

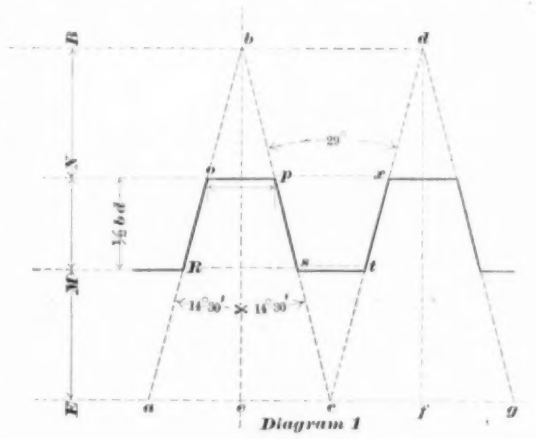

Diagram 1

Construction

$B\,E = b\,e = a\,e$ cot $a\,b\,e = a\,e$ cot 14° 30′

$B\,E = E\,M + M\,N + N\,B$

$E\,M = N\,B \qquad P\,X = R\,S$

$M\,N = ½\,b\,d = a\,e = ½ \div$ No. Thread per inch

$o\,p = N\,B$ tan 14° 30′ × 2 = $s\,t$

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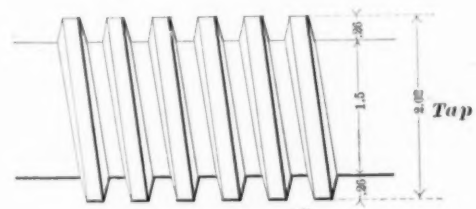

Diameter Screw 2″
" Tap 2.02″
" Tap Drill 1⅞″ +.02″

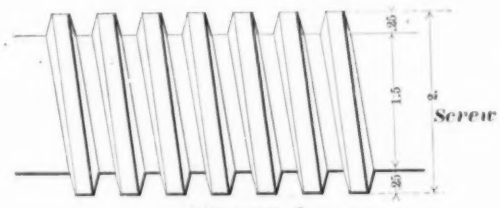

Diagram 4

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Comparison

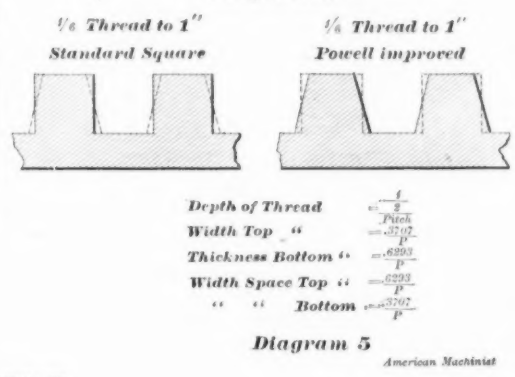
⅛ Thread to 1″
Standard Square
⅛ Thread to 1″
Powell improved
Depth of Thread = ½ ÷ 2 ÷ Pitch = .3707 ÷ P
Width Top " = .3707 ÷ P
Thickness Bottom " = .6293 ÷ P
Width Space Top " = .6293 ÷ P
" " Bottom " = .3707 ÷ P

Diagram 5

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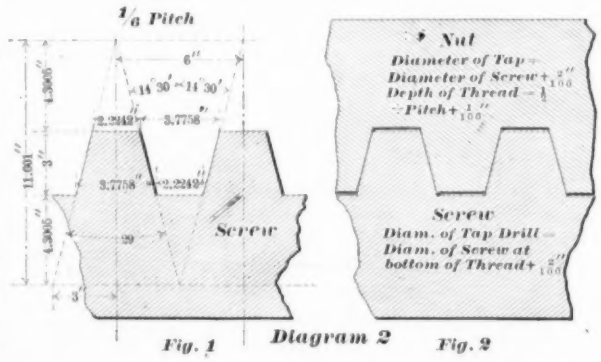

Fig. 1 Diagram 2 Fig. 2

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NEW SCREW THREADS.

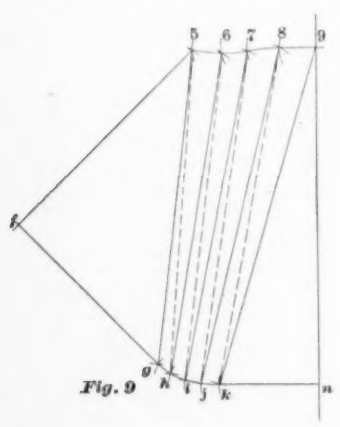

Fig. 9

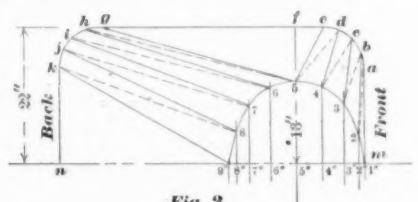

Fig. 2

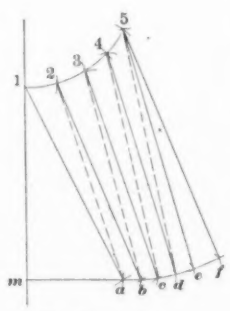

Fig. 8

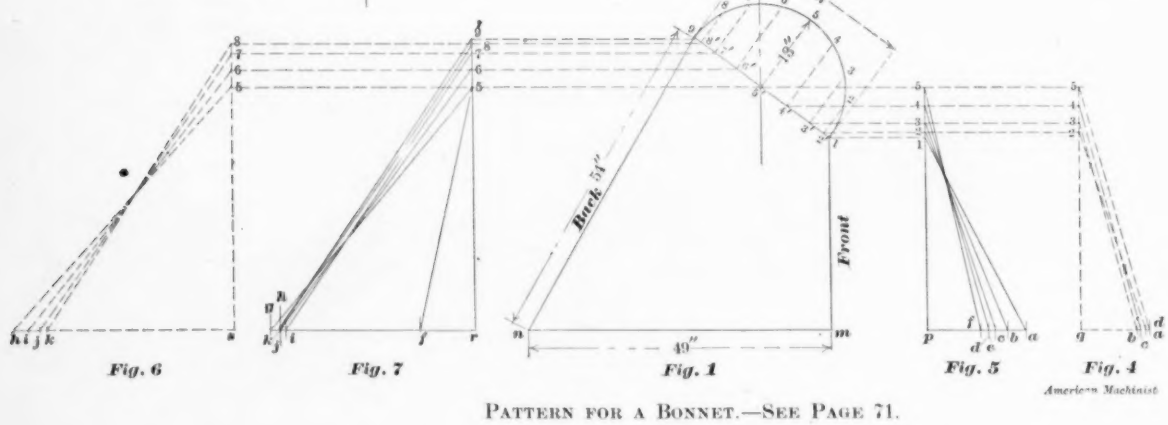

Fig. 6 Fig. 7 Fig. 1 Fig. 5 Fig. 4

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PATTERN FOR A BONNET.—SEE PAGE 71.

TABLE OF DIMENSIONS.

Pitch. No. Threads to One Inch.	Depth of Thread.	Width at Top Equals Width Space at Bottom of Thread.	Thickness at Root Equals Width Space at Top of Thread.
½	1″	.7414	1 2586
1	1/2″	.3707	6293
2	1/4″	.1853	.3147
3	1/6″	.1235	.2058
4	1/8″	.0927	1573
5	1/10″	.0741	.1259
6	1/12″	.0618	.1049
7	1/14″	.0529	.0899
8	1/16″	.0463	.0787
9	1/18″	.0413	.0699
10	1/20″	.0371	.0629

the additional strength at the root as well as the greater wearing surface, owing to the angle of sides, at the same time this angle is not so great as to materially change the direction of the axial force on which the screw acts, consequently the friction will not be immaterially increased from the square thread.

Pattern for a Bonnet.

BY GEO. GUNTZ.

I have received a sketch of a bonnet or a tapered pipe, and I am asked to give a method for laying out the pattern for the same. I understand that the base of this bonnet is to be rectangular in form, 49 inches long and 44 inches wide; the corners are to be drawn with a radius of 6½ inches, and the upper opening is to be elliptical in form, the major axis being 27 inches and the minor axis 26 inches; the plane of the opening is not to be parallel to the base. A side elevation of this bonnet is shown in Fig. 1, and a half plan in Fig. 2. These two views are necessary for laying out the pattern. I also take it for granted that the seams are to be at the sides; under these conditions we require two patterns; if the seams are to be on the ends, then one pattern only will be needed. The choice of position of these seams is, however, governed by the convenience of cutting the pieces out of the material. I shall assume that the seams are to be at the sides.

The true form of the upper opening is shown by the semi-ellipse in Fig. 3, the line 1–9 being the major axis. For the purpose of projecting this ellipse into the plan Fig. 2, and also for laying out the patterns, divide the semi-circumference of this ellipse, Fig. 3, into any even number of equal parts —eight in this case—this will give four equal parts to the front corner, and the same number of equal parts for the back corner. Through the points of division 2, 3, 4, etc., draw lines perpendicular to the major axis 1–9, meeting it in the points 2′, 3′, 4′, etc. In order to project this semi-ellipse into the plan, draw vertical lines through the points 1, 2, 3′, 4′, etc., cutting the center line *n m* in Fig. 2 in the points 1″, 2′, 3″, 4″, etc. Now make 2–2′ in Fig. 2 equal to 2–2′ in Fig. 1, 3–3′ equal to 3–3′, 4–4′ equal to 4–4′, etc.; through the points 1″, 2, 3, 4, etc., in Fig. 2, draw a curve which will be the horizontal projection of the semi-ellipse.

The next step will be to divide each of the two corners or arcs *g k* and *a e*, Fig. 2, into four equal parts, that is, into the same number of equal parts as there are in one-half of the semi-ellipse, and then join the points of division *a*, *b*, *c*, *d* and *e* to 2, 3, 4 and 5 by the full and dotted straight lines; also join the points *g*, *h*, *i*, *j*, *k* to 5, 6, 7, 8 and 9 by straight lines, as shown. We must now find the true lengths of all these lines; for this purpose we construct the four sets of triangles shown in Figs. 4, 5, 6 and 7. The hypothenuse of each triangle in Fig. 4 shows the true length of one of the dotted lines in the front corner Fig. 2, and those in Fig. 5 show the true lengths of the full lines in the same corner, and Figs. 6 and 7 show the true lengths of the straight lines in the back corner. For obtaining these lengths, produce the base line *m n* in Fig. 1 both directions, and from any point *q*, Fig. 4, draw a line perpendicular to it; through the points 2′, 3′, 4′ and 5′, Fig. 1, draw lines parallel to the base line, cutting the perpendicular in the points 2, 3, 4 and 5. From *q* set off on the base line a number of distances equal to 2 *a*, 3 *b*, 4 *c* and 5 *d*, as given in Fig. 2, and mark the extremities of these distances respectively *a*, *b*, *c*, and *d*. In Fig. 4, join by straight lines the points *a* and 2, *b* and 3, *c* and 4, *d* and 5; these lines will be the true lengths of the corresponding dotted lines in Fig. 2. In a similar way, we obtain the true lengths of the full lines in the front corner shown in Fig. 2. Thus, Fig. 5, through any point *p* on the base line erect a perpendicular, cutting the horizontals through the points 1, 2′, 3′, 4′ and 5′ shown in Fig. 1, in the points 1, 2, 3, 4, and 5. From *p* set off on the base line distances *p a*, *p b*, *p c*, *p d*, and *p f*, respectively, equal to the length of the full lines 1 *a*, 2 *b*, 3 *c*, 4 *d*, and 5 *f* in Fig. 2; then in Fig. 5 join the points 1 *a*, 2 *b*, 3 *c*, 4 *d* and 5 *f* by straight lines which give the true lengths of the lines similarly marked in Fig. 2. In the same way, the sets of triangles in Figs. 6 and 7 are constructed; we simply erect perpendiculars from any points *r* and *s* on the base line; then in Fig. 7 set off on the base line from *r* a number of distances *r g*, *r h*, *r i*, *r j* and *r k* equal to lengths of the full lines 5 *g*, 6 *h*, 7 *i*, 8 *j*, and 9 *k*, and then draw the triangles. In Fig. 6, set off on the base line from *s* the distances *s h*, *s i*, *s j* and *s k* respectively equal to lengths of the dotted lines 5 *h*, 6 *i*, 7 *j*, and 8 *k*, as shown in Fig. 2, and then draw the triangles, as is plainly indicated in Fig 6.

We are now ready to lay out the patterns, and will commence with the pattern shown in Fig. 8, which is for the front corner. Draw the line 1 *m* and make its length equal to 1 *m* in Fig. 1. Take *m a*, Fig. 2, and set it off from *m*, in Fig. 8, to *a*. Then take the distance 1–2, Fig. 3, and set it off from 1 to 2, Fig. 8; then take the hypothenuse 1 *a*, Fig. 5, and from 1, Fig. 8, as a center set it off cutting *m a* in *a*; and take 2 *a*, Fig. 4, and from *a*, Fig. 8, as a center cut 1–2 in 2. Then take *a b*, Fig. 2, and set it off as *a b*, Fig. 8; take 2–3, Fig. 3, and set it as 2–3, Fig. 8; then take 2 *b*, Fig. 5, and with 2, Fig. 8, as a center cut *a b* in *b*, and with 3 *b*, Fig. 4, with *b*, Fig. 8, as a center cut 2–3 in 3; next take *b c*, Fig. 2, and set it off as *b c*, Fig. 8, and 3–4, Fig. 3, and set it off as 3–4, Fig. 8, and 3–*c*, Fig. 5, with 3, Fig. 8, as a center cut *b–c* in *c*; and with *c*–4, Fig. 4, with *c*, Fig. 8, as a center cut 3–4 in 4. Then take *c–d*, Fig. 2, and set off *c–d*, Fig. 8, and 4–5, Fig. 3, and set off 4–5, Fig. 8; then take 4 *d*, Fig. 5, and with 4, Fig. 8, as a center cut *c–d* in *d*, and with *d*–5, Fig. 4, with *d* as a center cut 4, 5 in 5, then set off *e–f*, Fig. 2, as *e f*, Fig. 8; then take *e*–5, Fig. 5, and with *e*, Fig. 8, as a center cut 4, 5 in 5, and finally take *f*–5, Fig. 7, and from 5, Fig. 8, as a center cut *e f* in *f*; connect the points 1, 2, 3, 4, 5 with a curve; do the same with the points *a*, *b*, *c*, *d*, *e*, and connect the other points with straight lines. Allow for lap on the outside of 5 *f* where the seam comes, and one-half of the pattern of the front is complete; it is only necessary to duplicate this half and join it on at 1 *m* to complete the whole pattern.

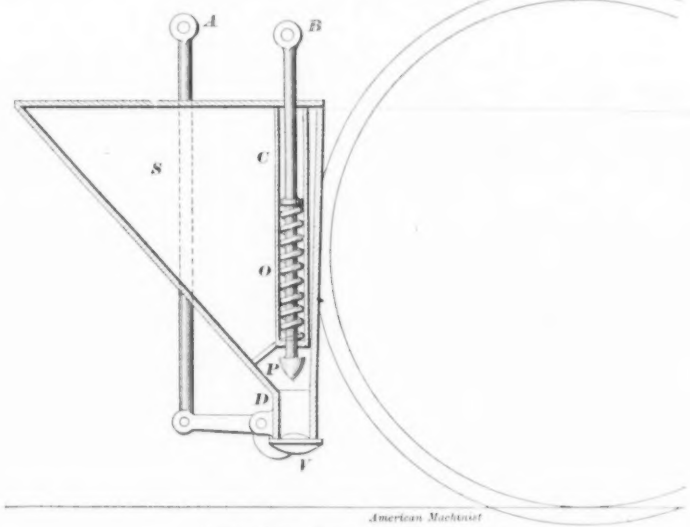
In a similar manner, we develop the pattern for the last half of the bonnet. It will be noticed that we commenced in the center of the pattern and worked towards the end, so we will again begin in the middle by taking the line *n* 9, Fig. 1 (that is the 54 inches up the back) and setting it off on a vertical line *n*–9, Fig. 9; then take the distance *n–k*, Fig. 2, and set it off from *n* to *k*, Fig. 9, and take 9–8, Fig. 3, and set it off as 9–8, Fig. 9; then take 9–*k*, Fig. 7, and with 9, Fig. 9, as a center cut *n k* in *k*. And take 8 *k*, Fig. 6, and with *k* as a center cut 9–8, Fig. 9, in 8, and continue this operation to the finish, as was done with the pattern for the front.

My correspondent complains to the effect that the method of triangulation is a very particular process; he says if you make a mistake you are gone. Now, right here, I want to say that if he or any other boiler maker wants to do things right, he must take time and be particular in order to save time as well as stock, for in guessing at anything like this you are likely to be gone 99 times out of 100. It is easily seen that it is more profitable to get it right at once as to try to guess at it. It is true that the method seems complicated, but it is with this as with everything else—easy enough when you know how.

Sand Box for Street Cars.

With this we give an illustration of a sand box recently brought out by Emil Heiz, Bell Building, Paterson, N. J. It is suitable for and can be readily applied to trolley cars. The aim in the design of the box is to insure, in case of an emergency when a quick stop is necessary, a sufficient supply of sand to the rails without waste or emptying all the sand out of the box, so that no supply will be available in case of an emergency which may occur a few minutes later.

The device for attaining the desired ends is very simple. A valve *V*, pivoted at *D* and operated by the rod *A*, opens the aperture at the bottom of the box; the object of this valve is mainly to prevent a collection of mud in this aperture, which must necessarily be placed comparatively close to the rails, and consequently there is a great liability of its being choked with mud, which in cold weather is liable to freeze and render the sand box useless, unless, of course, a device like this valve is used for preventing an occurrence of this kind. This valve also serves another useful purpose, it tends to spread the sand on the rail.



SAND BOX FOR STREET CARS.

To further insure action, and also for preventing a waste of sand, the rod *B* with its plug-formed end *P* is used. This rod passes through a casing *C* which is firmly attached to the inside of the sand box. The spiral spring *O* acts against the bottom of the casing and against a collar on the rod *B*, always tending to lift the latter. The rods *A* and *B* are connected to a foot pin which passes through the platform of the car within easy reach of the motorman. The connections are such as to cause the plug *P* to descend, and the valve to open whenever a pressure is applied to the foot pin, and as soon as the pressure is relaxed the spring *O* will push the rod *B* upwards and close the valve *V*.

The diameter of the plug *P* is less than that of the aperture so as to leave an annular opening of sufficient width for a suitable supply of sand, and at the same time preventing a sudden emptying of the sand. The plug as it descends pushes out any obstruction that may have collected in the aperture, and by giving the foot pin a few strokes in quick succession the plug is made to act as an agitator so as to insure a flow of sand.

The advantages of a sand box of this kind are apparent; the waste of sand is to a great extent prevented, and consequently the liability of having no sand in the box when wanted, and failure of action are reduced, all of which tend to avoid serious consequences when a quick stopping of the cars is absolutely necessary.

Condition and Prospects of the Machinery Business.

LETTERS FROM MACHINERY MANUFACTURERS TO THE "AMERICAN MACHINIST."

In our first two issues for this year, we printed a large number of letters from machinery manufacturers and those in kindred lines of industry, as to the state of business. We publish below a few additional ones, which for various reasons were delayed and could not therefore appear with the others.

Faneuil Watch Tool Co. (Fine Watch Tools and Machinery), Boston, Mass., write us:

We have had about the same percentage of increase in our business for 1894 as we have had in former years, and the outlook for 1895 is even better. We have been running every day, full time, with our regular help all the past year, as indeed we have ever since we started, and we have added several new and improved machines to our equipment this last year.

We consider that we owe our good business rather to the fact that our bench lathes are getting better known, than to any general improvement in business, as it is chiefly on these lathes that we have made our gain this year, and we have several big orders for them unfilled as yet.

John L. Kelley (Kelley's Patent Specialties, Stop Governors, Automatic Steam Flue Cleaners, Adjustable Steel Flue Scrapers, Adjustable Screw Plates, Low Water Alarms, Speed Indicators, Gauge Glass Cutters, Adjustable Hose Clamps, Metallic Oil Cans), Erie, Pa., writes us:

Our trade has been poor up to the middle of November, when it took a decided change for the better. The prospects are not so bright now as a month ago, but as our trade depends largely on the prosperous conditions of the industries of the country, our business will fluctuate accordingly. We have strong hopes, but they may not materialize. We have brought out some new tools, which will be included in our new catalog.

Chas. A. Strelinger & Co. (Hardware, Tools and Supplies, Machinery), Detroit, Mich., write us:

Our business for the past year, while far from satisfactory, was a decided improvement over '93.

We are firm believers in the old adage, "In time of peace, prepare for war," and in the past eighteen months of comparatively peaceful business life, we have been busily engaged in preparing our new catalog, which we have termed "A Book of Tools." It has been a very difficult and onerous task, being constructed on lines that are comparatively new, and had it not been for the business depression we hardly know when it would have been completed, so this is the "silver lining" to our cloud.

We have every reason to look forward to an increased business during the coming year.

J. E. Reinecker (Machine Tools, Relieving Lathes for Making Milling Cutters), Chemnitz-Gablenz, Germany, writes us:

In regard to last year's business, I am happy to report that it proved a good one for my works in spite of the ruling dullness in most lines of manufacturing.

Besides an increasing demand in tools like taps, dies and die stocks, twist drills, caliper gauges and principally in formed cutters, in which line I hardly could keep up, I did a very good business in machines for producing tools, principally in relieving lathes, also in outfits for making twist drills, our big concerns tending to making their own tools.

At present I employ 300 men, with 285 machine tools, which is an increase of more than 10 per cent. against January last year. I am obliged to work overtime, my works being crowded to the utmost, but I will add an extension 200x93 feet as soon as weather will allow. Wages did not vary to a perceptible amount.

MANUFACTURING

The W. F. Robertson Steel and Iron Co. is the successor to the business of Evans & Robertson, Cincinnati, Ohio, Mr. W. F. Robertson having purchased the interest of Mr. Charles W Evans.

The Berlin Iron Bridge Co., of East Berlin, Conn., are putting up a new retort for the Elersl'e Gas and Coke Co., at Winifred Junction, W. Va. The building is 66 feet wide and 84 feet long, with an iron roof covered with slate.

The Philadelphia Engineering Works, Philadelphia, Pa, have issued a calendar which has on it a table of sizes and horse-powers of different proportions of tandem and cross compound, condensing and non-condensing engines. Aside from its utility as a calendar this table will be found of service to those who have to do with engines.

We have received from Ernest F. Robbins, Burrville, Conn., a standard size (6″x9″) catalog, illustrating and describing, particularly, lathe attachments, and other tools used in machine shops, such as draw chucks, surface gauges, turrets, box tools, die holders, hollow mills, arbors, knurls, milling cutters, etc. It is sent to those interested on application.

We have received from Francis W. Clough, Springfield, Mass., an illustrated catalog of mechanical specialties for draftsmen, machinists and tool makers. In this catalog will be found matter of considerable interest to the class of men named, and it is sent to those interested on application. We may add that in hight, this catalog lacks one-half inch of being standard.

We have received from the Keuffel & Esser Co., 127 Fulton street, New York, a new catalog of specialties for draftsmen and engineers, which is something out of the usual order for such catalogs, being illustrated, not by engravings, which have become thoroughly familiar to everybody by long service in various catalogs of this character, but by special engravings, illustrating only the productions of the company named. The catalog is in other respects a very fine and very complete one of standard size (6″x9″), well printed and well bound with over 400 pages and a complete index. It is a catalog well worth having by every manufacturer and draftsman.

The Tradesman, Chattanooga, Tenn., in its report on the industrial condition of the South for the week ending January 14th, says: The iron producing industry continues to be active. Four furnaces are to go into blast at once; three at Sheffield, Ala., and one at Covington, Va. Southern coal miners are now mining and selling more coal than ever before, and the market for coke can hardly be supplied, owing to the demands of the furnaces. Southern coke has been greatly improved in quality by the use of coal washers, with which all the principal plants are now supplied. The lumber market is improving. Louisiana cypress is in good demand at advancing prices, and poplar is scarce. The official figures of the Poplar Association, furnished to *The Tradesman*, show that for 1894 the poplar cut was 56 per cent. of that of a normal year, the shipments 90 per cent. and the stock on hand 40 per cent. The interest shown by Northern capitalists in Southern locations for their cotton-mills continues to increase. The Boott mills and the Massachusetts mills, both of Lowell, Mass., have applied for charter amendments to permit them to build in the South. It is understood that the last named company will locate at Athens, Ga. Cotton-mills, each with $100,000 capital, have been organized during the week at Birmingham, Ala., and Wilmington, N. C., and one with $50,000 capital at Irene, S. C. Others are reported at Ozark, Ala., Flora, Miss., Charlotte and Shelby, N. C., and Portsmouth, Va., and a $50,000 cotton-mill enlargement at Raleigh, N. C.

Machinists' Supplies and Iron.

NEW YORK, January 19, 1895.

Iron—American Pig—We quote standard brands, $12 to $12.50 for No. 1; $11 to $12 for No. 2, and $10.50 to $11 for No 2 Plain. Southern brands, $11.25 to $11.50 for No. 1; $10 25 to $11 for No. 2; $10 to $10.50 for No. 3; $10.50 to $10 75 for No. 1 soft; $10.25 to $10.75 for No. 2 soft; and Foundry No. 4, $9.50 to $10.

Antimony—The jobbing business continues fair, and with the exception of a decline in one brand, there is no change in prices. We quote L. X., 8¼c. to 8¾c.; Cookson's, 8½c. to 8¾c.; Hallett's, 7.30c. to 7.35c.; and U. S. French Star, 8c.

Lard Oil—Prime City we quote at 55c. to 56c.

Copper—The market remains steady, and considerable business has been transacted. Lake Copper is quoted at 10c.; consumers do not care to pay this price, and hold back; they can get it a little cheaper from second-hands. The demand for Casting Copper at 9.50c. is good.

Lead—The market is firm, the metal is scarce, and not much business has been done. For New York delivery 3½c. is asked.

Spelter—The market is dull, and the demand is small. For New York delivery 3.30c. will buy.

Tin—The market has a firmer tendency, but prices are lower. For spot 13.15c., and for futures 13 25c. and upward were quoted.

✻WANTED✻

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Wanted—A situation as foundry foreman. Address Founder, care J. W. See, Hamilton, Ohio.

Mech. draftsman wants position; good refs. N. Y. preferred. Box 94, AMERICAN MACHINIST.

Competent mech eng'r & draftsman wants steady position; highly recommended. F. F., AM. MACH.

Wanted—Pos. by skilled mech. draftsman, A1 refs. Address Box 96, AMERICAN MACHINIST.

Draftsman with gas engine experience desires permanent position. Gas Eng., AM. MACHINIST.

Toolmaker and draftsman wants position. Address Z., North Vineland, N. J.

Wanted—Sit. by chief draftsman & designer; 15 years exp. in shop & drawing room, versed in mod. methods & shop practice. Box 91, AM. MACHINIST

Wanted position as foreman—Patternmaker, ten years' exp. with large heavy work, foreman at pres. with large firm, wishes to change. Box 95, AM. MACH.

A live Yankee foreman desires to make change, where energy and experience will be appreciated. Address Box 97, AMERICAN MACHINIST.

Draftsman, 15 years' exp. as designer of steam engines, electric and gen. mach'y, seeks pos. as chief draftsman. Chief Draftsman, AM. MACHINIST.

Toolmaker desires to change; first-class on fine automatic machinery & experimental work; screw & milling tools; first-class refs. Box 101, AM. MACH.

Wanted—Exp'd mechanical draftsman for detail shop drawings; state exp., & wages expected; permanent work for active, competent man. The Western Gas Construction Co., Fort Wayne, Ind.

Salesman Wanted—To sell a well known steam packing to mills, electric plants and steamships. Must have thorough knowledge of steam plants. Address, stating exp., "Steam," AM. MACHINIST.

Foreman wanted in a machine shop where the work is of a general character; capacity for 100 men, new equipment, location near New York. Address Foreman, AMERICAN MACHINIST.

Engineer (mem. A. S. M. E.) at present superintendent of manufacturing concern desires changing location to New England; will consider salary or purchase of interest. Box 100, care AM. MACHINIST.

Wanted at Cleveland, Ohio—Foreman for small machine shop working on repair work; applicant must have prac. experience with fair education. Address in his own hand writing, stating age, exp., education & wages expected, Box 92, AMER. MACH.

18 years' experience large concerns; machine tools, rolling-mill, sheet metal working, hydraulic machinery, and in charge of men; technical, practical. 1st-class draftsman and designer, desires pos. as supt., ass't supt., dftsman. Hombre, AM. MACH.

A first-class boilermaker, who can lay out work and handle men profitably for his employers, wants a position as foreman; over ten years in last position; reference A1. Address Box 98, AMERICAN MACHINIST.

Wanted—A manager for a steam forge, comprising smith shop and fully equipped machine shop. Applicants please apply by letter, with full particulars and references. Address Room 75, 54 William street, New York City.

Mechanical draftsmen (a), one experienced in special mach'y & tools for light manufacturing; (b) one experienced in mill engineering. Address, giving age, exp., refs. and compensation expected, The Yale & Towne Manufacturing Co., Stamford, Conn.

Wanted—A position as supt. or foreman; 28 years exp.; watch tools & automatic mach'y, sewing machines and tools, jigs, dies, etc.; have had charge; conversant with mod. methods; familiar with shop accounts. 1st-class ref. Box 102, AM. MACHINIST.

(*Continued on Page 73.*)

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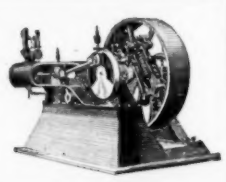

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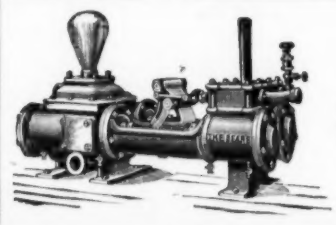

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87 MAIDEN LANE, N. Y. JERSEY CITY, CHICAGO, PHILADELPHIA, BOSTON, LONDON

WANTED

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Wanted—Five first-class tool makers, accustomed to light work such as sewing machines, watches, bicycle tools, etc.; none but experienced first class workmen with good references need apply; steady employment and good wages. The National Cash Register Co., Dayton, Ohio.

Wanted, immediately—First-class foreman for blacksmith shop running 15 fires; must be expert in all kinds of blacksmith work & hard'g tools, dies, etc.; none but first-class man need apply. Address, stating exp. as foreman & wages expected, John Kruesi, General Manager General Electric Co., Schenectady, N. Y.

Machine tool designers or foremen capable of taking full charge of a shop; preferably those prepared to acquire a substantial interest in a well established, paying stock company, contingent upon both parties found suitable, are invited to address (in confidence) B., AM. MACHINIST. Start in any time before March 1. Location Philadelphia.

Wanted—A first-class man to run a B. & S. case-hardening furnace, and do all hardening and tempering in connection with manufacturing and tool making in a shop employing 150 men on work similar to sewing machine work. State experience and wages expected. None but experienced and well recommended men need apply to Box 99, AMERICAN MACHINIST.

The head designer and draftsman in a large machine shop desires evening employment in N. Y. City of any kind or description; steam, electric, hydraulic, tools or general machine work; parties rushed with work or wishing assistance in working out mechanical problems for the shop, patent office or courts can have competent assistance by addressing Experience, AMERICAN MACHINIST office.

MISCELLANEOUS WANTS

Advertisements will be inserted under this head at 35 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cheap 2d hd lathes & planers. S.M.York,Clev'd,O.

Best Steel Flue Scrapers. Kelley Co., Erie, Pa.

Calipers & Gauges. F. A. Welles, Milwaukee, Wis.

For Sale—Second-hand drill presses, engine lathes & planers. Dietz, Schumacher & Co., Cincinnati, O.

Light and fine mach'y to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Wanted—A purchaser for a good key-seater, by Mitts & Merrill, 913 Tilden Street, Saginaw, Mich.

Wanted—To buy good second-hand tools. Box 83, AMERICAN MACHINIST.

"Draftsmen's combination triangles clean, transparent, tough." D. J. Kelsey, New Haven, Conn.

Model Locomotive Castings. Latest design. G. H. Olney, 163 Herkimer street, Brooklyn, N. Y.

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Every mechanic should have a copy of "Pocket Primer of the Air Brake." Sent to any address for 50 cents. W. S. Rogers, Buffalo, N. Y.

Wanted—The address of a firm for steam laundry supplies. Send particulars to H. H., care of J. Piotrowski, a co-advertising agency, Warsaw (Poland), Senatorska 26.

Designing and drafting done at home by two mechanical engineers of large experience in mechanical and electrical work; new ideas worked out. Address M. S., AMERICAN MACHINIST.

Wanted—One iron planer 32x32x10 feet; one iron planer 20x20x4 feet; one screw-cutting lathe 24 or 26-inch swing, 16 or 18 feet bed; one key-seating machine; one gear cutter; modern tools in good order; second-hand. Address Field Force Pump Co., Lockport, N. Y.

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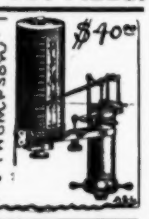

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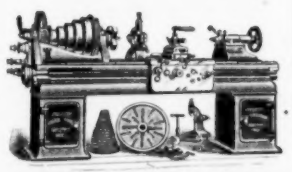
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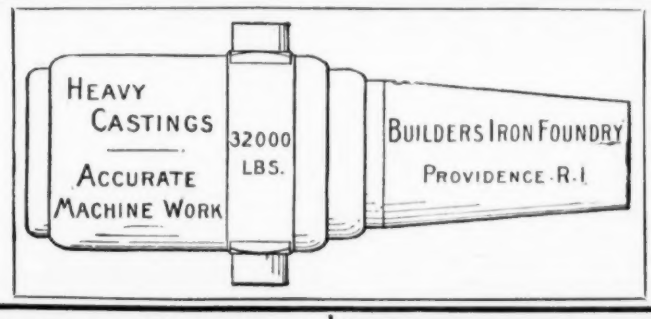

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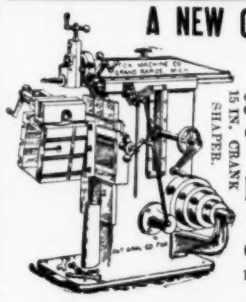

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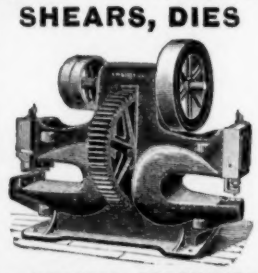

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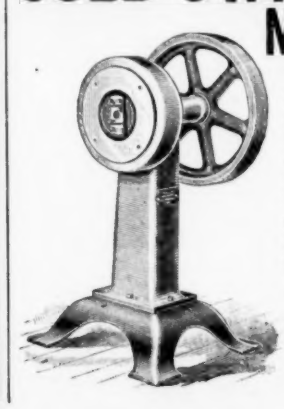

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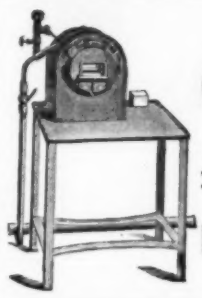

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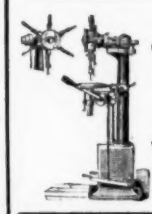

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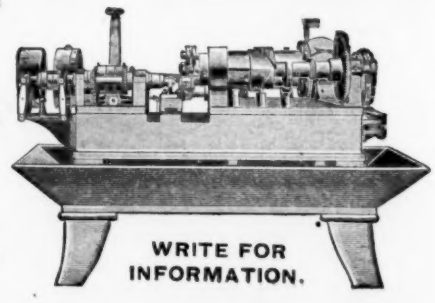

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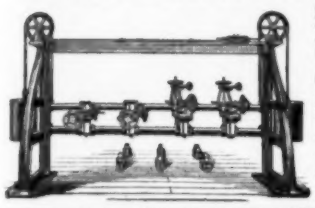

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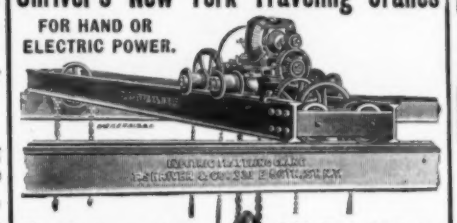

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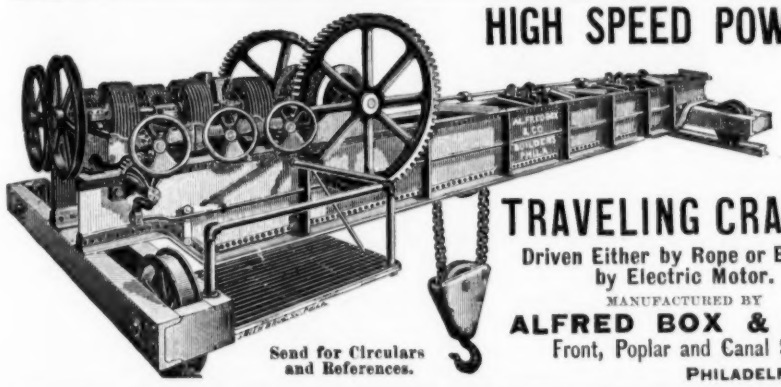

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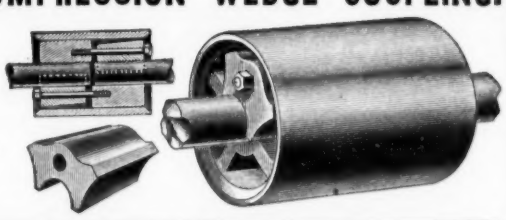

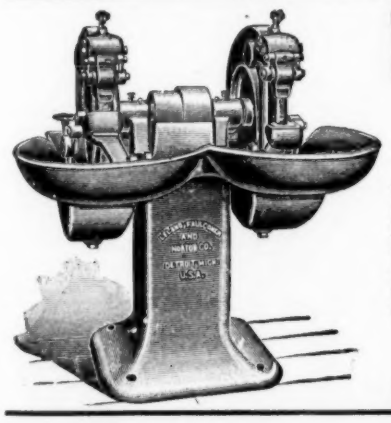

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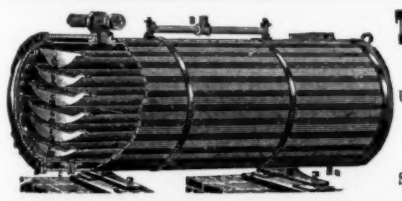

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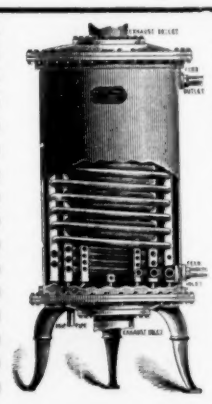

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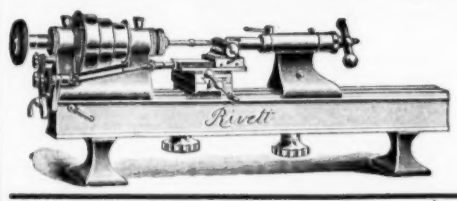

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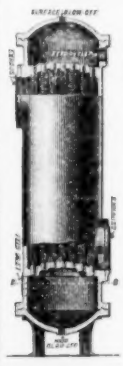

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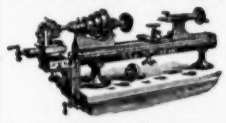

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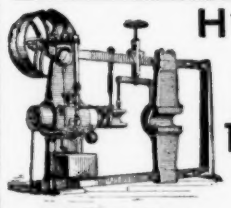

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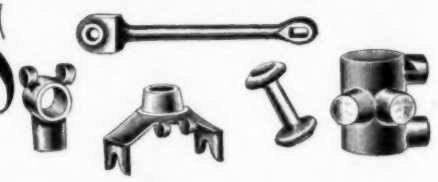

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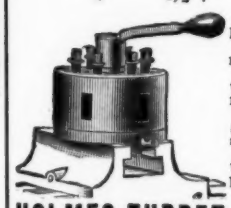

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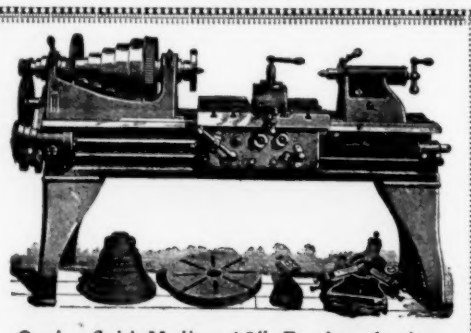
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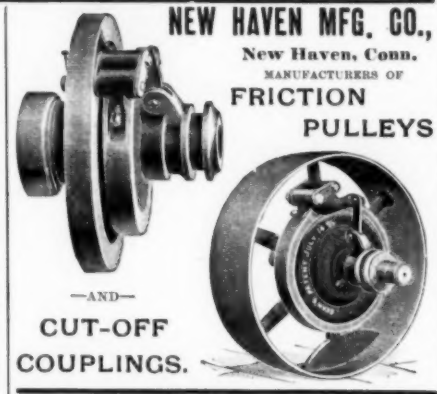

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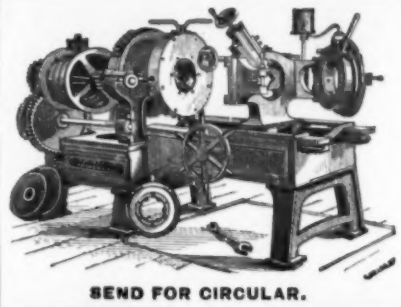

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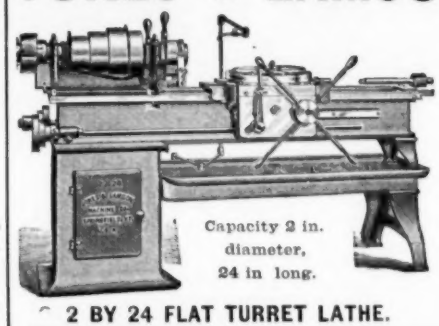

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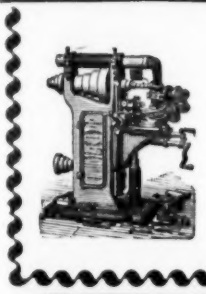

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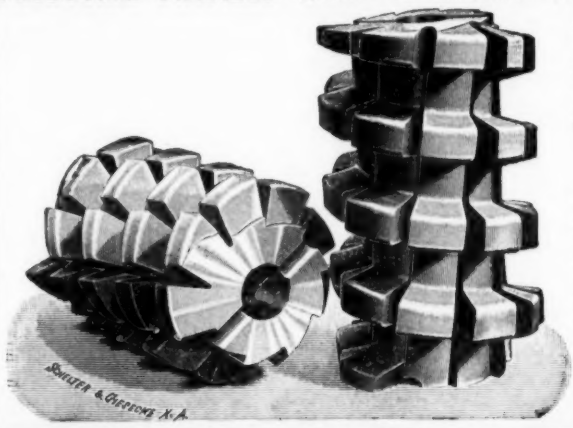

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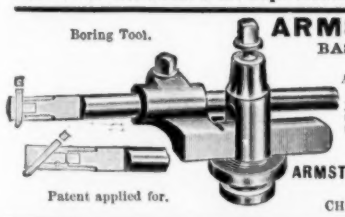

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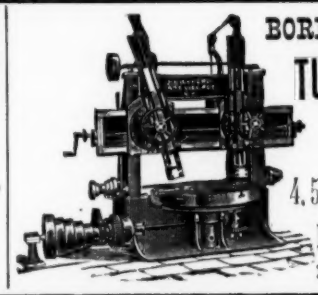

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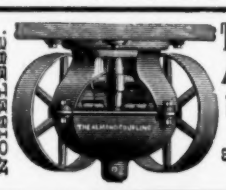

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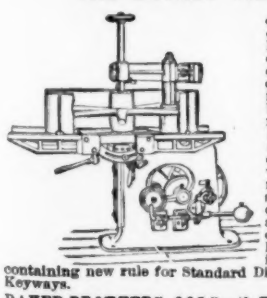

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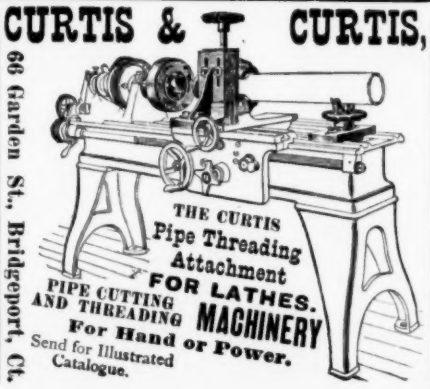

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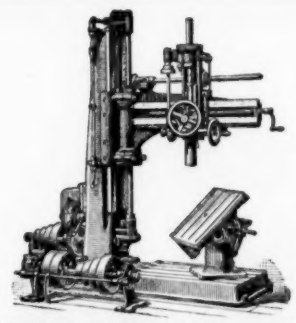

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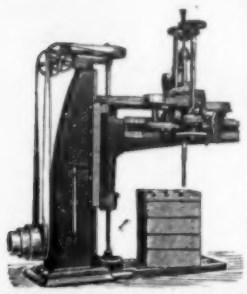

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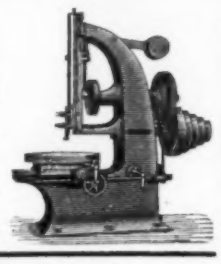

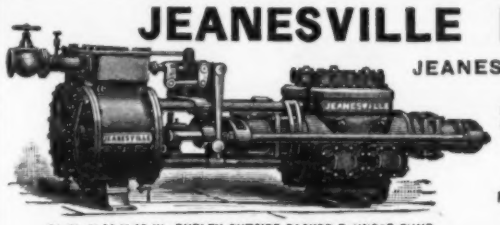

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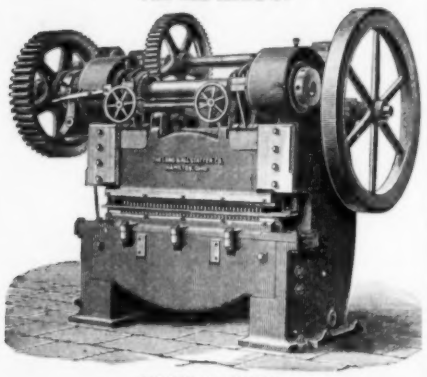

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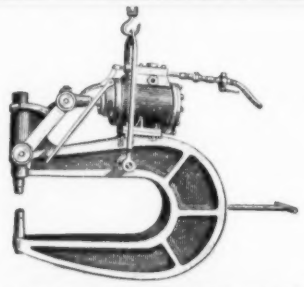

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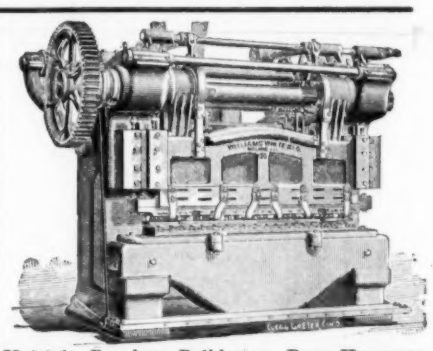

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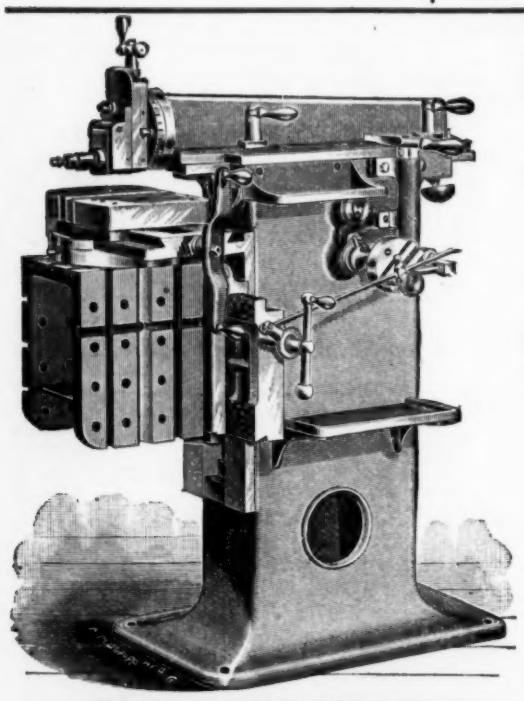

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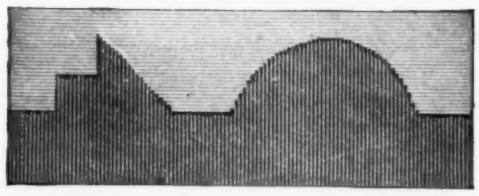

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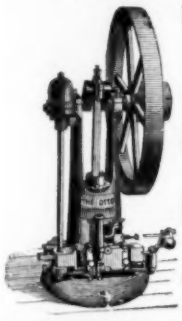

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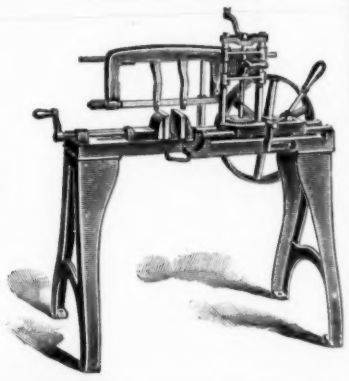

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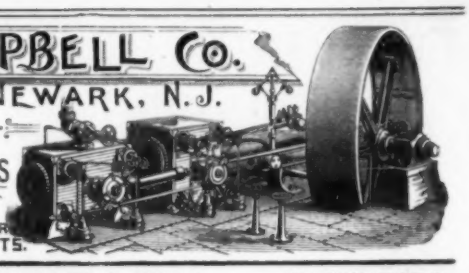

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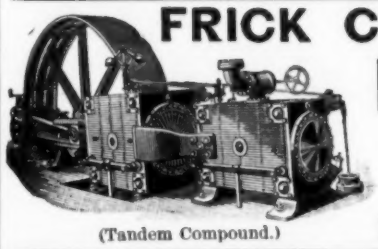

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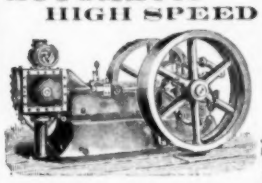

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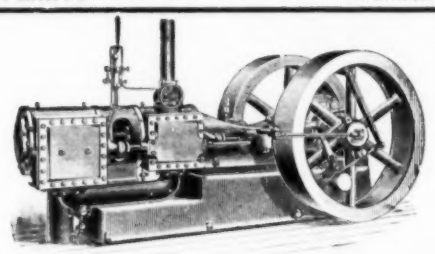

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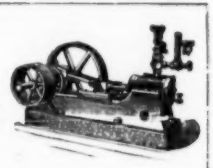

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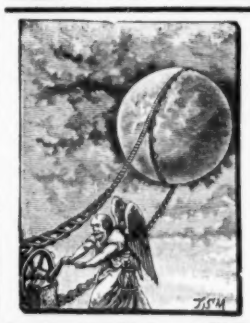

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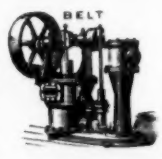

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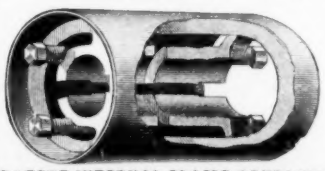

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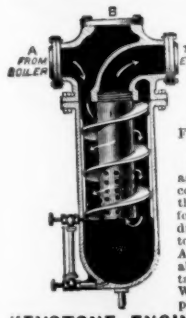

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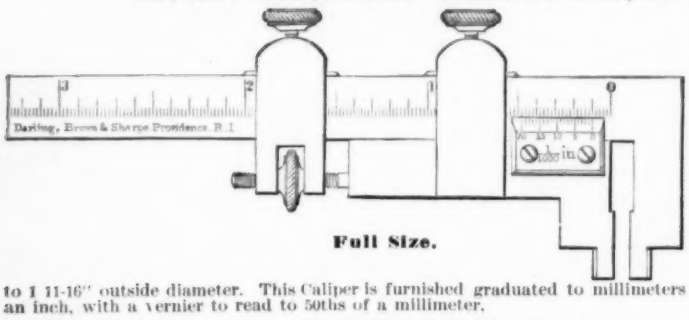

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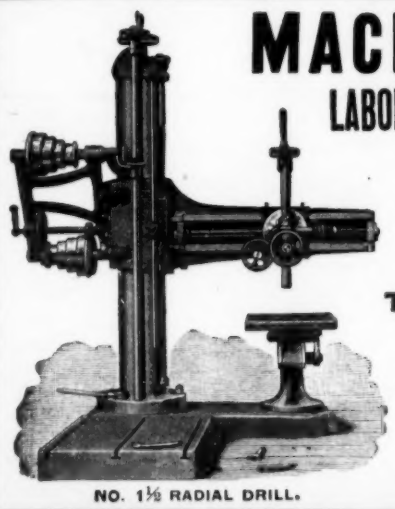

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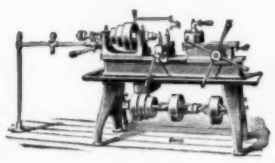

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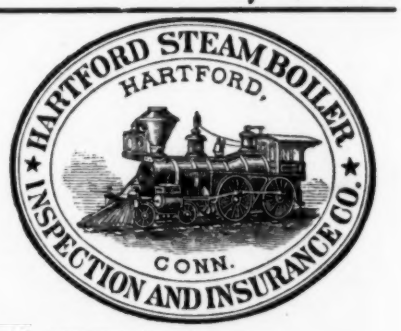

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